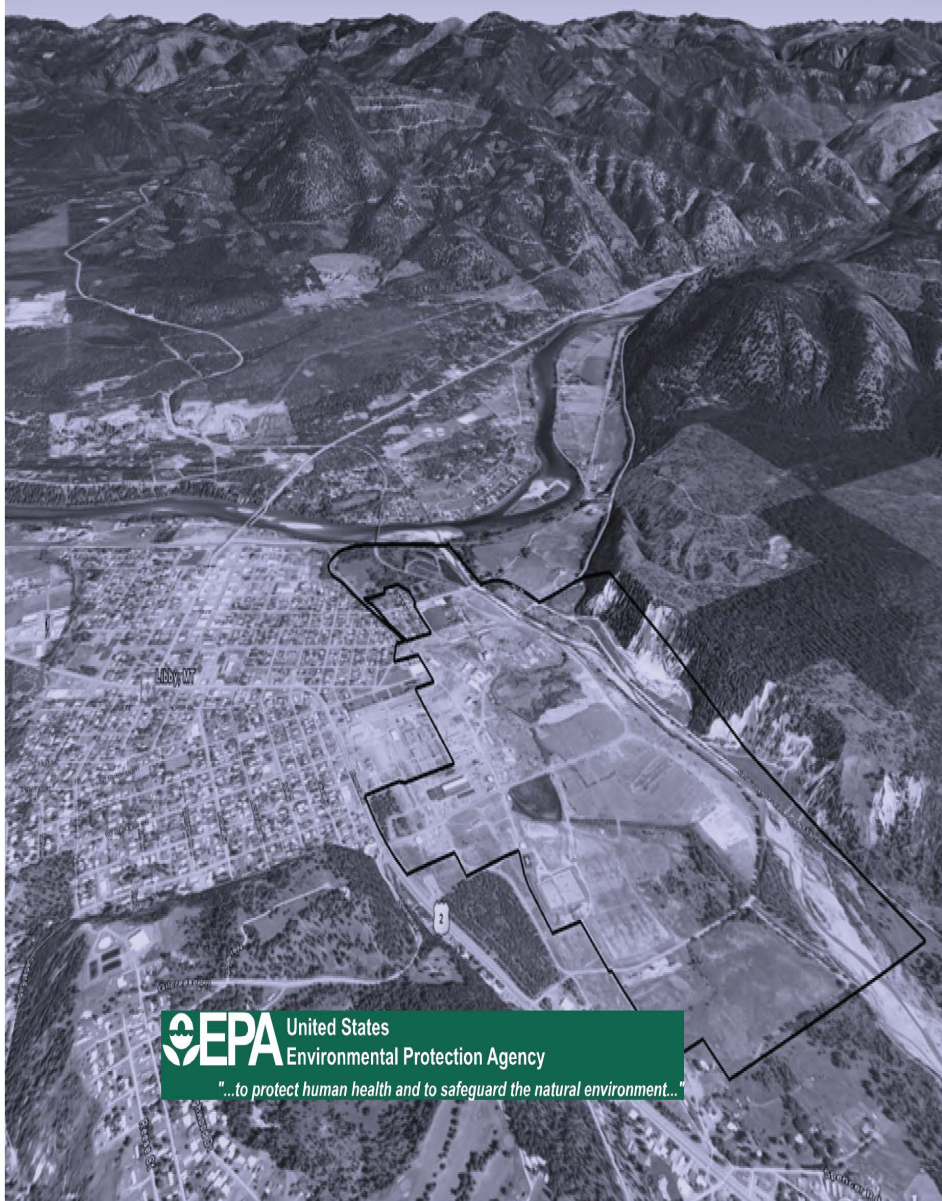


FINAL Remedial Investigation Report

Libby, Montana

Operable Unit 5 Libby Asbestos National Priorities List Site



June 2013



United States
Environmental Protection Agency

"...to protect human health and to safeguard the natural environment..."

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June
2013

Prepared for
US Environmental Protection Agency

by

HDR Engineering, Inc.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1.0 INTRODUCTION.....	1-1
1.1 OVERVIEW AND REPORT ORGANIZATION	1-1
1.2 NPL SITE LOCATION & TOPOGRAPHY	1-2
1.3 NPL SITE HISTORY.....	1-3
1.4 OU5 HISTORY AND DESCRIPTION	1-3
1.5 REGULATORY HISTORY	1-5
1.6 PREVIOUS RESPONSE ACTIONS AT OU5.....	1-5
1.7 PREVIOUS INVESTIGATIONS & REPORTS	1-7
1.8 LIBBY GROUNDWATER SITE	1-7
2.0 SITE CHARACTERISTICS.....	2-1
2.1 CLIMATE	2-1
2.2 GEOLOGY.....	2-1
2.3 HYDROLOGY AND HYDROGEOLOGY	2-2
3.0 SAMPLING AND ANALYSIS	3-1
3.1 SAMPLE TYPES AND COLLECTION PROCEDURES	3-1
3.1.1 Air Samples.....	3-2
3.1.2 Dust Samples	3-3
3.1.3 Soil Samples.....	3-4
3.1.4 Waste Bark.....	3-6
3.2 SAMPLE PREPARATION AND ANALYSIS	3-6
3.2.1 Air and Dust.....	3-6
3.2.2 Soil and Bulk Material	3-7
3.2.3 Waste Bark.....	3-9
4.0 DATA RECORDING, DATA QUALITY ASSESSMENT, AND DATA SELECTION	4-1
4.1 DATA RECORDING	4-1
4.2 DATA QUALITY ASSESSMENT	4-1
4.3 DATA SELECTION	4-2
5.0 NATURE AND EXTENT OF LA	5-1

5.1	CONTAMINANTS OF CONCERN.....	5-1
5.2	LA IN AIR	5-1
5.3	LA IN DUST	5-2
5.4	LA IN SOIL	5-3
5.5	LA IN WASTE BARK	5-4
5.6	Supplemental Studies	5-5
6.0	CONTAMINANT FATE AND TRANSPORT	6-1
7.0	HUMAN HEALTH RISK ASSESSMENT.....	7-1
8.0	CONCLUSIONS	8-1
9.0	REFERENCES.....	9-1

LIST OF TABLES

1-1	Response Actions Taken at OU5
3-1	Sampling Events at OU5
3-2	Visible Vermiculite Inspection Scores and Selected Locations for Outdoor Worker ABS

LIST OF FIGURES

1-1	OU Boundaries
1-2	Libby Groundwater Superfund Site
1-3	OU5 Land Uses and Building Locations
1-4	Building and Soil Abatement Response Actions
3-1	Surface Soil Sampling Locations
5-1	ABS Indoor Air Results
5-2	ABS Outdoor Air Results
5-3	LA in Indoor Dust
5-4	LA in Surface Soil – PLM Results
5-5	Visible Vermiculite in Surface Soils
5-6	LA and Visible Vermiculite in Sub-Surface Soil

APPENDICES

A – Response Action Reports

- A1 – OU5 Redevelopment Area Investigation Summary
- A2 – Response Actions at Central Maintenance Building
- A3 – Libby and Troy Creek Investigation Summary Memo
- A4 – Completion Form for a Quick Response at the Plywood Plant.
- A5 – Completion Form for a Quick Response at the Valve House at Stimson Finger-Joiner Building
- A6 – Completion Form for a Quick Response at the Former Popping Plant on OU5.
- A7 – Completion Form for a Quick Response at the Lincoln County Port Authority Property (CDM Offices).
- A8 – Documentation of Soil Removal Activities at the Former Tree Nursery

B – Sample Phase List

C – Asbestos Analysis Methods and Data Reduction Techniques

D – Analytical and Other Data

- D1 – Scribe Database
- D2 – Scribe Queries

E – Data Quality Assessment

F – Supplemental Investigation Reports

- F1 – Wood Chip ABS
- F2 – Proposed Fishing Pond Pre-design Investigation (at Former Tree Nursery)

LIST OF ACRONYMS

ABS	Activity-Based Sampling
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	Below ground surface
DQA	Data Quality Assessment
DQOs	Data quality objectives
EDDs	Electronic data deliverables
EPA	U.S. Environmental Protection Agency
ERT	Emergency Response Team
FS	Feasibility Study
FSDS	Field sample data sheet
ft	Foot
GPS	Global Positioning System
ISO	International Organization for Standardization
KBPID	Kootenai Business Park Industrial District
LA	Libby Amphibole
LG Site	Libby Groundwater Superfund Site
Libby2DB	Libby 2 Database
mg/m ³	milligrams per cubic meter
msl	mean sea level
NPL	National Priority List
OSHA	Occupational Safety and Health Administration
OU	Operable Units
PAH	Polycyclic aromatic hydrocarbons
PCM	Phase Contrast Microscopy
PCME	Phase Contrast Microscopy Equivalent
PCP	Pentachlorophenol
PLM	Polarized light microscopy
PLM-VE	Polarized Light Microscopy – Visual Estimation
PRP	Potentially responsible parties
RI	Remedial Investigation
ROD	Record of Decision
s/cc	Structures per cubic centimeter
s/cm ²	Structures per square centimeter
SAP	Sampling and Analysis Plan
SOPs	Standard operating procedures
SQL	Structured query language
TEM	Transmission electron microscopy
µm	micrometer

EXECUTIVE SUMMARY

Overview

This Remedial Investigation (RI) Report describes the nature and extent of Libby amphibole (LA) asbestos at Operable Unit 5 (OU5) of the Libby Asbestos National Priority List (NPL) Site (the Site) located in Lincoln County, Montana. LA occurrence throughout the Site resulted from long time mining activities.

Operable Unit 5 is also referred to as the former Stimson Lumber Mill site, as many lumber processing facilities were located throughout OU5. The majority of lumber production activities ceased in 2003 when Stimson Lumber Company sold the property to the Lincoln County Port Authority and ownership was subsequently transferred to the current owner, Kootenai Business Park Industrial District (KBPID). The OU5 site is currently being redeveloped for a variety of uses, both recreational and industrial. Major site features and land uses are illustrated on Figure ES-1.

Gold miners discovered vermiculite in Libby in 1881; in the 1920s the Zonolite Company formed and began mining the vermiculite. In 1963, W.R. Grace bought the Zonolite mining operations which closed in 1990. While in operation, the Libby mine may have produced 80 percent of the world's supply of vermiculite. Vermiculite has been used in building insulation and as a soil conditioner.

Vermiculite often contained asbestos and therefore, vermiculite mining, processing, and shipping acted as a carrier to spread asbestos throughout Libby. Raw vermiculite ore was estimated to contain up to 26% LA.

Asbestos found at the Libby Site contains a variety of different amphibole types. Amphibole is the name of an important group of generally dark-colored minerals, forming prism or needlelike crystals. Because there are presently insufficient toxicological data to distinguish between the different forms of amphibole asbestos, the Environmental Protection Agency (EPA) evaluates all of the mine-related amphibole asbestos types together (referred to as LA). Asbestos exposure in humans may cause both cancer and non-cancer effects. Among them are:

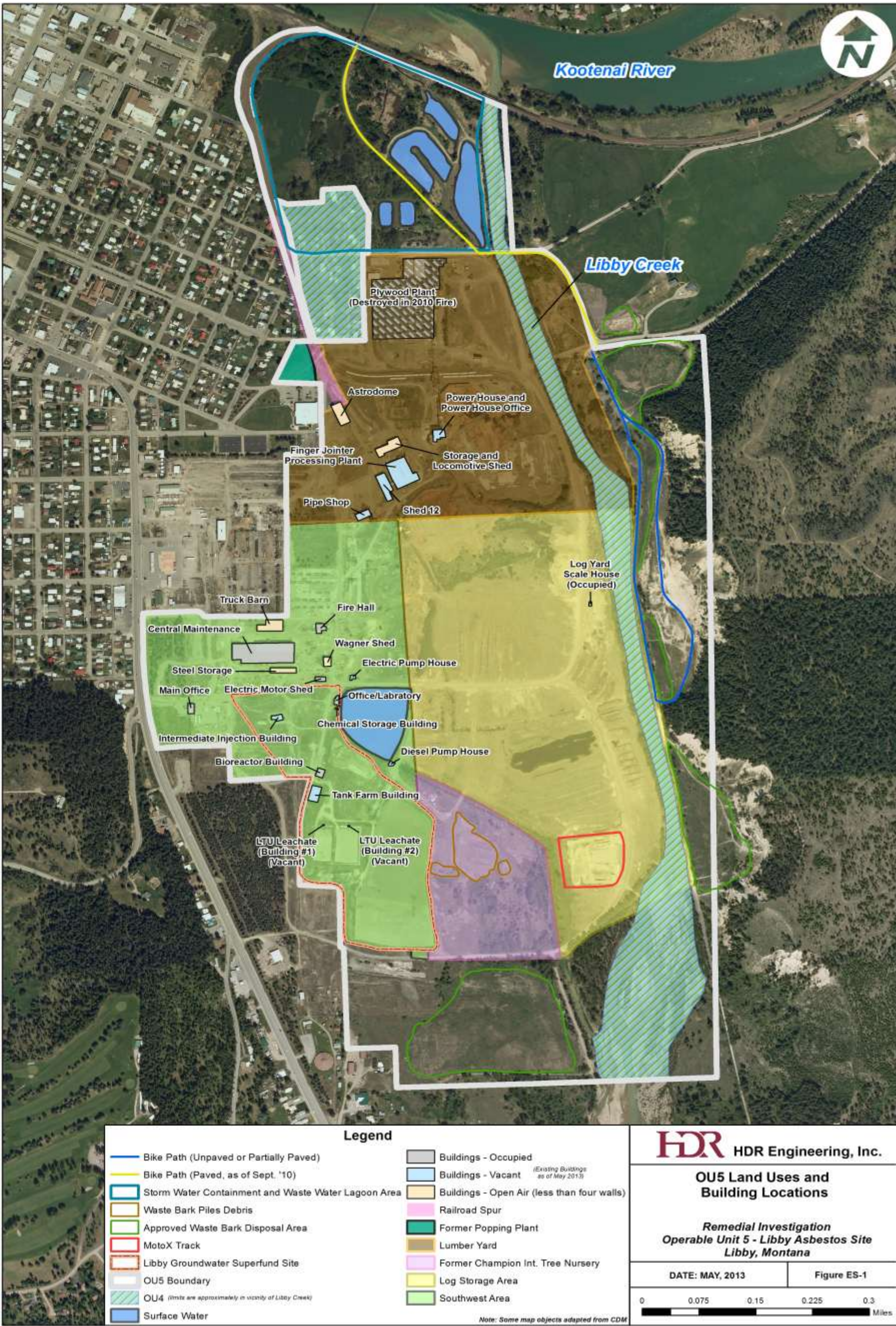
Non-Cancer Effects:

- Asbestosis
- Pleural Abnormalities

Cancer Effects:

- Lung cancer
- Mesothelioma

People who visit or work at OU5 may be exposed to LA by incidental ingestion of contaminated soil or dust and by inhalation of air that contains LA fibers. Of these two pathways, inhalation exposure is considered to be of greater concern as it is most often associated with disease of the respiratory system.



Asbestos fibers can be released into the air due to disturbance of asbestos containing environmental media such as soil. The amount of LA fibers released to air will vary depending upon the level of LA in the source material and the intensity and duration of the disturbance activity. Because of this, predicting LA levels in air associated with disturbance activities based only on measured LA levels in source material is extremely difficult. Therefore, the most direct way to determine potential exposures from inhalation is to measure, through sample and analysis, the concentration of LA in air during a specific activity that disturbs a source material. For convenience, this is referred to as activity-based sampling (ABS).

Site Investigations

Investigations at OU5 began in May of 2002 and continued through 2012. EPA performed several ABS studies at in 2007 and 2008 to investigate levels of LA in air associated with a variety of activities under current conditions. In addition to the ABS studies, the following additional media-specific sampling was conducted:

- Dust - standing dust samples collected from horizontal surfaces inside buildings.
- Soils
 - Surface – composite and grab samples collected from 0 to 6 inches below ground surface (bgs).
 - Sub-surface – composite and grab samples collected 6 or more inches bgs.
- Waste Bark - material samples from an existing waste pile.

ABS from most occupied buildings contained detectable levels of LA. For buildings where LA was detected, the mean concentration varied by a factor of 1,000. LA was detected in seven of the eight outdoor worker ABS areas. The mean LA concentration varied by a factor of 10 across the seven areas where LA was detected. Sampling at the MotoX area included stationary samplers proximal to the location of spectators as well as samplers fixed to the handlebars of dirt bikes. No LA fibers were detected in any air sample.

ABS was conducted separately for paved and unpaved portions of the bike path. On the paved path, a stationary air monitor was also mounted in a trailer attachment to one of the bicycles to characterize potential exposures to a young child being pulled by a parent. Mean LA concentrations for the adult and child are similar.

Of the 87 indoor dust field samples collected, 28 samples had detectable levels of LA. Only four samples had levels of LA above the current EPA removal action level for indoor dust (> 5,000 total LA structures per square centimeter).

Soil samples were examined both visually for vermiculite and by polarized light microscopy (PLM). PLM results are generally non-detect or trace across OU5. The one location where PLM results have consistently been higher (with observed LA levels up to 1%) is the north-central portion of the former Tree Nursery area (Figure ES-1). This location also has elevated visible vermiculite scores.

Of the 19 waste bark samples analyzed, LA was detected in 1 sample analyzed by PLM and 13 samples analyzed by transmission electron microscopy. These results indicate that LA is present but it is not possible to quantify how much LA may be present based on this qualitative method.

Risk Assessment

An evaluation of potential exposures to and risks from LA will be included in the site-wide risk assessments for the Libby Asbestos Superfund Site. Site-wide risk assessments are stand-alone documents which support the feasibility study and record of decision (ROD).

1.0 INTRODUCTION

1.1 OVERVIEW AND REPORT ORGANIZATION

This Remedial Investigation (RI) Report describes the nature and extent of Libby amphibole (LA) asbestos and associated human health risks at Operable Unit 5 (OU5) of the Libby Asbestos National Priority List (NPL) Site (the Site). LA occurrence throughout the Site resulted from long time mining, processing and shipping activities and the use and handling of materials which contained LA.

U.S. Environmental Protection Agency (EPA) has had a presence in Libby since 1999 and has completed a number of sampling activities and clean up efforts. The EPA determined there was imminent and substantial endangerment to public health from asbestos contamination in various types of source materials in and around Libby.

In light of evidence of human asbestos exposure and associated increase in health risks, it was recommended that EPA take appropriate steps to reduce or eliminate exposure pathways to these materials to protect area residents and workers. In 2002, the Libby Asbestos Superfund Site was included on the National Priorities List which, due to its large size, has been divided into eight Operable Units (OUs):

- OU1 – Former Export Plant
- OU2 – Former Screening Plant
- OU3 – Mine Site
- OU4 – Residential and commercial properties in and around Libby
- OU5 – Former Stimson Lumber Mill
- OU6 – Rail Line
- OU7 – Residential and commercial properties in and around Troy
- OU8 – US and Montana State highways and secondary highways in the vicinity of Libby and Troy, Montana.

Figure 1-1 presents a map showing the entire NPL area and boundaries of all OUs. This RI addresses OU5, which is located south of the incorporated limits of Libby and contains the former Stimson Lumber Mill and all properties owned by Kootenai Business Park Industrial District (KBPID). The OU5 boundary also encompasses the unrelated Libby Groundwater Superfund Site (LG Site), which has been on the NPL since September 1983 due to groundwater contamination resulting from wood preservative processing (Figure 1-2). While the LG Site is separate from LA investigations described in this RI, the land surface within the LG Site was sampled as part of the OU5 investigation. In addition, air samples were taken at buildings within the LG Site.

Libby Creek (which is part of OU4) traverses the western portion of OU5, but is not part of OU5. Therefore, it will not be discussed in this report.

The RI Report is organized into the following major sections:

Section 1 – Introduction – This section describes the purpose of the RI and summarizes prior work and NPL Site history.

Section 2 – Site Characteristics – This section provides a brief description of Site setting, climate, geology, hydrogeology, and surface water hydrology.

Section 3 – Sampling and Analyses – This section discusses sample types and collection methods and analytical techniques.

Section 4 – Data Recording, Data Quality Assessment, and Data Selection – This section discusses the Libby database, quality control measures and how data were selected to produce the final OU5 data set used to describe the nature and extent of contamination and for calculation of health risk estimates.

Section 5 – Nature and Extent of Contamination – This section provides a description of the current type and extent of LA in surface and subsurface soils, indoor and outdoor air and bulk materials. In addition, a brief discussion of groundwater conditions is provided associated with the LG Site underlying portions of OU5.

Section 6 – Contaminant Fate and Transport – This section provides a qualitative discussion of LA contaminant migration routes and persistence in the environment.

Section 7 – Baseline Risk Assessment – This section discusses the human health and ecological risk assessment.

Section 8 – Conclusions – This section presents general conclusions.

Section 9 – References – This section provides full references for all citations in the body of the report.

1.2 NPL SITE LOCATION & TOPOGRAPHY

The City of Libby, Montana is located in the northwest corner of the state, 35 miles east of Idaho and 65 miles south of the Canadian border (Figure 1-1). It is at an elevation of approximately 2,580 feet (ft) above mean sea level (msl). The source of LA, Vermiculite Mountain, is located approximately 7 miles northwest of Libby. The city has a total area of 1.3 square miles and lies in a valley carved by the Kootenai River and bounded by the Cabinet Mountains to the south.

The OU5 site is relatively flat and slopes slightly towards the north north-east. It encompasses approximately 400 acres and includes a number of commercial and industrial buildings as well as areas used for recreation.

1.3 NPL SITE HISTORY

Libby is located near a large open-pit vermiculite mine which is located on Vermiculite Mountain. Vermiculite is mica-like mineral that can be processed for use as an insulating material or soil amendment and has been mined in Libby from 1919 to 1990. It is estimated that the Libby mine was the source of over 70 percent of all vermiculite sold in the U.S. from 1919 to 1990. Over its lifetime, it employed more than 1,900 people. W. R. Grace bought the mine and processing facility in 1963 and operated it until 1990 (EPA, 2010a)

Vermiculite from this mine contains varying levels of amphibole asbestos, consisting primarily of winchite and richterite, with lower levels of tremolite, magnesiorichterite, and possibly actinolite. Because existing toxicological data are not sufficient to distinguish differences in toxicity among these different forms, the EPA does not believe that it is important to attempt to distinguish among these various amphibole types. Therefore, the EPA simply refers to the mixture as Libby amphibole (LA) asbestos. Historic mining, milling, and processing operations as well as bulk transfer of mining-related materials, tailings, and waste to locations throughout the Libby Valley, are known to have resulted in releases of vermiculite and LA to the environment. This has caused a range of adverse health effects in exposed people, including individuals who did not work at the mine or processing facilities

The EPA has been working in Libby since 1999 when an Emergency Response Team (ERT) was sent to investigate local concern and news articles about asbestos-contaminated vermiculite. Since that time, the EPA has been working closely with the community to clean up contamination and reduce risks to human health.

Based on health risks associated with asbestos, which include asbestosis, lung cancer and mesothelioma, the EPA placed the Libby Asbestos Site on the NPL in October 2002.

Libby, Montana, which is the Lincoln County seat, has a population of less than 3,000, and 12,000 people live within a ten-mile radius. While Libby's economy is still largely supported by natural resources such as logging and mining, there are also many tourist and recreational opportunities in the area.

1.4 OU5 HISTORY AND DESCRIPTION

Operable Unit 5 is also referred to as the former Stimson Lumber Mill site, as many lumber processing facilities were located throughout. The J. Neils Lumber Company began wood treating operations at OU5 in approximately 1946. The lumber company and wood treating operation was purchased by St. Regis Corporation in 1957. Champion International Corporation purchased the facility in 1985 who then sold it to Stimson Lumber Company in 1993.

The majority of lumber production activities ceased in 2003 when Stimson Lumber Company sold the property to the Lincoln County Port Authority and ownership was subsequently

transferred to the current owner, KBPID. The Site is currently being redeveloped for a variety of uses, both recreational and industrial.

Figure 1-3 shows former and current land uses and buildings throughout the Site that existed in June 2010. One of the largest structures at OU5, the Plywood Plant, was entirely destroyed by fire in early 2010.

During Site interviews conducted in 2001, three specific outdoor subareas of interest were identified (CDM, 2007a) due to potential vermiculite (and associated LA) contamination concerns (Figure 1-3):

- The former Popping Plant was once used as an aboveground storage area for uncontained vermiculite ore. Ore was stockpiled directly on the native soil surface in this area.
- The Railroad Spur was used for shipping raw and unprocessed vermiculite material to and from OU5.
- The former Tree Nursery may have introduced raw vermiculite product into this area as a growth medium and fill material.

Additionally, waste bark piles remain from historical lumber processing activities at OU5.

Under current conditions, OU5 is used mainly for commercial/industrial purposes. Portions of the Site are used for recreational purposes. This includes an area that has been developed as a Moto-Cross (MotoX) Park for dirt biking riding, and a trail along Libby Creek that is popular for hiking and bicycle riding. Most of these features are illustrated on Figure 1-3.

Currently, there is no residential land use on OU5. However, a residential area (part of OU4) lies within the OU5 boundaries as shown on Figure 1-3. In addition, residential neighborhoods surround OU5 to the west and northwest.

Redevelopment plans are currently being formulated for OU5. The Kootenai River Development Counsel was awarded a grant to upgrade the rail lines and electrical system throughout the Site. Plans have also been developed for a walking path and fishing pond.

Limited tree and grass plant species are located within OU5, primarily along the northern boundary and surrounding Libby Creek. The majority of OU5 is un-vegetated and suitable for industrial/commercial development.

1.5 REGULATORY HISTORY

The following is a brief chronological summary of major regulatory actions taken at the Site.

- 1999 – Local concern alerts EPA to investigate asbestos in and around Libby, Montana
- 2002 – Libby Asbestos Site proposed for the NPL
- 2002 – Libby Asbestos Site formally added to the NPL
- 1999 through 2013 – Response actions taken to remove asbestos and vermiculite containing material throughout OU5 (Table 1-1)

EPA has not entered into any enforcement agreements or issued any orders for investigation, removal, or remedial work at any part of OU5. The Stimson Lumber Company removed some loose and accessible vermiculite insulation in 2002 and 2003. EPA contractors have taken samples at OU5 many times beginning in 2002. EPA removed vermiculite insulation from a portion of the roof and walls at the Central Maintenance Building in 2005 and contamination from surface soils several times since 2009. None of these actions was pursuant to any enforcement agreement or order. EPA entered into a site wide settlement with the only Potentially Responsible Party (PRP) for OU5, W. R. Grace, in 2008. That agreement provided for a cash settlement of past and future response costs for the entire Libby NPL Site except OU3, the mine site.

1.6 PREVIOUS RESPONSE ACTIONS AT OU5

EPA established a program to inspect all properties in Libby. The emergency response work in Libby has focused on removing as many LA source areas as possible from all OUs. Contaminated soils are transported to the former Libby Mine site and contaminated construction debris is placed in a specially designed landfill cell. These disposal sites are secured and will remain off-limits to human contact. Recent response efforts have focused on residences and businesses. Currently, the EPA is transitioning from emergency removal activity to the Remedial Process (EPA, 2010a).

In an effort to determine the extent of LA occurrence at OU5, there have been multiple sampling investigations conducted since 2002. These investigations are discussed in detail in Sections 3 and 5 of this report. A number of response actions have been completed to date and are summarized in Table 1-1. Those buildings and land areas subjected to prior response actions that remain at OU5 are illustrated on Figure 1-4.

The only known source of residual indoor vermiculite is at the Central Maintenance Building, where remnants of vermiculite insulation remain in wall cavities (CDM, 2007a). However, the possibility exists for residual vermiculite to be present in other OU5 buildings.

Beginning in October 2006, EPA implemented the Environmental Resource Specialist (ERS) program for the entire Libby Superfund Site, including OU5. This program was set up to assist

with unplanned and urgent exposures to vermiculite attic insulation due to its association with LA. The ERS program provides a full-time service where property owners, firemen, and other affected personnel or citizens can obtain access to LA expertise outside the normal course of scheduled clean-up actions. The ERS program currently responds to reports of residual vermiculite in OU5 buildings.

In addition to addressing vermiculite (and associated LA) in buildings, EPA performed other response actions involving OU5 soils (Figure 1-4):

- OU5 Redevelopment Area – Soil characterization and limited soil removal in an area west of the Pipe Shop. A summary of investigative and soil removal work is provided as Appendix A1.
- Central Maintenance Building – Multiple actions to remove vermiculite-containing building and other materials by vacuum methods, from the edge of the walls and outward approximately 45 ft. A summary of investigative and soil removal work as well as asbestos containing building materials mitigation is provided as Appendix A2.
- Libby Creek Remediation Area – Removal and replacement of rip-rap on the east bank of Libby Creek. Libby Creek is a part of OU4 as it traverses OU5. However, a portion of the response action may have encroached onto OU5 on the east bank of the creek. A summary of investigative and soil removal work is provided as Appendix A3.
- Former Plywood Plant – Soil removal north of the former veneer dryer and removal of vermiculite-containing bricks. A Completion Form is provided as Appendix A4.
- Valve House at Finger Joiner Building – Soil removal from the area surrounding the Valve House and from the floor of the Valve House. A Completion Form is provided as Appendix A5
- Former Popping Plant location – Soil removal as part of an OU4 action that extended onto OU5. A Completion Form is provided as Appendix A6.
- Port Authority Building (CDM Offices) – Soil removal as part of a re-vegetation pilot study. Documentation is provided in Appendix A7.
- Former Tree Nursery Area – Soil removal in preparation for construction of a proposed fishing pond in the area. A Completion Form is provided as Appendix A8.

In addition, EPA installed a chain-link fence to isolate the former Tree Nursery area (CDM, 2007a).

1.7 PREVIOUS INVESTIGATIONS & REPORTS

Numerous reports have been published dating back to 2007 that describe Site characteristics, as well as conditions on the entire NPL site. Many reports are considered relevant to the OU5 RI and are listed by primary subject as follows:

Sampling and Analysis Plans

- *Sampling and Analysis Plan, Building Data Gap Sample Collection, CDM, Final – 11/2/07*
- *Sampling and Analysis Plan, Initial Soils Data Gap Sample Collection, CDM, Final – 9/10/07*
- *Sampling and Analysis Plan Addendum - Initial Soils Data Gap Sample Collection, Visual Vermiculite Inspection, CDM, Final – 6/13/08*
- *Sampling and Analysis Plan for the MotoX, U.S. Department of Transportation, Final – 8/19/08*
- *Sampling and Analysis Plan for Outdoor Worker Exposures, Syracuse Research Corp., Final – 9/8/08*
- *Sampling and Analysis Plan for Recreational User Exposures, Syracuse Research Corp., Final – 9/8/08*
- *OU5 Activity Based Sampling, Soil Pilot Study (Modification to MotoX ABS SAP & Outdoor Worker ABS SAP), CDM, Rev 1 – 11/28/09*

Reports on Investigation Results

- *Data Summary Report, CDM, Final – 9/10/07*
- *Sampling Summary Report – 2007 Investigations, CDM, Final – 7/25/08*
- *OU5 Wood Chip ABS Sampling Summary Technical Memorandum, CDM Smith – 1/9/12*

1.8 LIBBY GROUNDWATER SITE

The LG Site lies within the OU5 boundary but is otherwise, unrelated to OU5 (Figure 1-2). A brief chronology and description of the LG Site history is provided below:

- In 1979, contamination was discovered in a nearby residential drinking water well. Contaminants include creosote, PCP (pentachlorophenol), and PAH's (polycyclic aromatic hydrocarbons).
- LG Site added to the NPL on September 8, 1983. It has two designated OUs:
 - LG-OU1 consists of the alternative drinking water supply initiative sponsored by Champion (a PRP) for the affected and potentially-affected residents of Libby.
 - LG-OU2 consists of affected environmental media including contaminated soils, and groundwater in the upper and lower aquifer.

- LG-OU1 Record of Decision (ROD) was finalized on September 26, 1986. The remedy included:
 - Champion's Buy Water Plan in which Libby residents were provided monetary compensation for using municipal water supply for irrigation and drinking water instead of contaminated private water wells.
 - An ordinance preventing installation of new water wells for human consumption or irrigation in the upper and lower aquifer within the "corporate limits" for the City of Libby.

- LG-OU2 ROD was finalized on December 30, 1988. The remedy included but is not limited to:
 - Excavation of contaminated soils from identified source areas and placement within a waste pit to undergo a two-step enhanced biodegradation process. The solids were transferred to a land treatment unit, which ultimately will be capped with low permeability materials.
 - Insertion of language into the current registered deed identifying locations of hazardous substances disposal and treatment areas, and land use restriction of these areas.
 - Oil recovery wells to collect highly-contaminated ground water, which is treated in a fixed film bioreactor prior to reinjection.
 - In-situ enhanced bioremediation of upper aquifer ground water.
 - Monitoring activities to assess performance of remedy components throughout the life of remedial activities.

Four 5-year reviews have been performed at the LG Site, with the most recent signed on March 5, 2010. The review found the current remedies for LG-OU1 and LG-OU2 to not be protective. The remedy for LG-OU2 does not include institutional controls on a portion of the contaminated groundwater plume. The remedy for LG-OU2 does not currently meet risk-based cleanup levels. Environmental clean-up activities at the LG Site will continue into the future.

2.0 SITE CHARACTERISTICS

2.1 CLIMATE

Annual average precipitation in Libby is 24.7 inches, with an annual average of 105 inches of snowfall (WRCC, 2010). Precipitation and humidity in Libby are greatest during the winter months due to the presence of temperature-regulating Pacific air masses. In December and January, average temperatures range between 25-30 °F. Occasionally, dry continental air masses occupy the Libby area for short periods of time during the winter, creating cold and less-humid conditions (CDM, 2009a).

Fog is common in Libby during winter months and in early morning throughout the year. Summer months are dryer and warm with occasional rainfall. The average July temperature ranges between 56-70 °F, with an average high of 80 °F (CDM, 2009a).

Prevailing winds are from the west north-west and average approximately 6-7 miles per hour. Wind direction and velocities fluctuate depending on temperature variances caused by vertical relief in the area. Inversions often trap stagnant air in the Libby valley (CDM, 2009a).

2.2 GEOLOGY

Regional geology in the Libby valley is comprised of lacustrine deposits underlain by Precambrian rocks. Surrounding mountains are formed by Precambrian rocks. Cliffs along the lower portion of the valley are formed by glacial lake bed deposits. The Kootenai River and Libby Creek cut through lacustrine and alluvial deposits and form a discontinuous sequence of gravel, sand, silt, and clay (EPA, 2010b).

Alluvial deposits extend from the surface to 190 ft bgs and are comprised of sand, gravel, silt, clay and cobbles. Glacial till, which consist primarily of silt and clay with varying amounts of sand and gravel underlies alluvial deposits. Deposits of glacial till are believed to be quite deep, occurring at depths exceeding 500 ft bgs (EPA, 2010b).

Soils in the Libby area typically are loamy soil composed of sand and silt with minor amounts of clay. Soil was formed by erosion of pre-Cambrian rocks, downstream transport of clays with rivers and creeks, and organic matter from historically forested areas (CDM, 2009a).

Site soils are a combination of historical soil modified in areas by human activities. These activities may include addition of vermiculite as a soil amendment, soil reworking for building construction, road and railroad operation, vermiculite processing and transport, and general site work.

2.3 HYDROLOGY AND HYDROGEOLOGY

Libby Creek (which is part of OU4) runs through the western portion of OU5 and terminates in the Kootenai River, which flows just outside the northern OU5 border. The Kootenai River originates in British Columbia, Canada, and flows through Montana and Idaho before returning to Canada and flowing into the Columbia River. Flows in the Kootenai River and Libby Creek are tied to runoff from the mountains surrounding Libby. Runoff peaks in spring when high-elevation snow begins to melt. Stream flow decreases in summer due to low precipitation and snowmelt flow moderation by high elevation lakes (CDM, 2009a).

Beneath OU5, saturated alluvial deposits extending from the surface to approximately 190 ft bgs have been sorted into three classifications: upper aquifer, intermediate zone, and lower aquifer. The upper aquifer contains high hydraulic conductivity material including silty gravel and sand with occasional interbedded clayey, silty deposits. It is unconfined and extends from the water table (5 to 30 ft bgs) to approximately 70 ft bgs. Hydraulic conductivity ranges from 100 to 1000 foot per day (ft/day). The inferred groundwater flow direction is north-northwest towards the Kootenai River (EPA, 2010b).

The intermediate zone is comprised of low permeability deposits similar to the upper aquifer, but with a higher percentage of fine-grained material. Acting as a confining layer, the intermediate zone is 40 to 60 ft thick, extending from approximately 60-70 ft bgs to 110 ft bgs. The hydraulic conductivity of this layer is much lower than the upper aquifer at approximately 1 ft/day.

The lower aquifer extends from approximately 100 ft bgs to 190 ft bgs, and contains more low-permeability silt and clay layers than the upper aquifer. It is confined and under pressure, so water in wells screened in this aquifer rise to 14-26 ft bgs. Hydraulic conductivity of the lower aquifer ranges from 50 to 200 ft/day. The inferred groundwater flow direction is north-northwest towards the Kootenai River (EPA, 2010b).

3.0 SAMPLING AND ANALYSIS

Investigations at OU5 began in May of 2002 and continued through 2012. Table 3-1 summarizes sampling events that occurred at OU5 over the ten-year sampling period.

The following sections describe sample types, sample collection and analytical methods. All sample media and associated analytical results are discussed in this Section. However, certain data are excluded from the discussion of nature and extent of LA occurrence (Section 4) including:

- Air, bulk material or other samples associated with a building/structure that has since been demolished or otherwise destroyed or has been cleaned under a removal action.
- Certain other data that was deemed irrelevant to the assessment of risk to human health. These include certain indoor dust and outdoor ambient air samples.

This was done to simplify and focus the description of nature and extent of LA occurrence to those measurements most relevant to the estimation of human health risks.

In addition, investigations performed after 2009 were in support of lumber product safety assessment or pre-design investigations related to site development. Data from these studies were also excluded from the body of the report. However, a summary of each investigation is provided in Section 5.

3.1 SAMPLE TYPES AND COLLECTION PROCEDURES

As shown in Table 3-1, the following media-specific sampling was conducted:

- Air
 - Personal air samples – collected using a sampling pump and filter located in the breathing zone of an individual while performing various activities indoors or outdoors.
 - Stationary air samples – collected using a stationary sampling pump and filter placed either indoors or outdoors.
- Dust - standing dust samples collected from horizontal surfaces inside buildings.
- Soils
 - Surface – composite and grab samples collected from 0 to 6 inches bgs.
 - Sub-surface – composite and grab samples collected 6 or more inches bgs.
- Waste Bark - material samples from existing waste pile shown on Figure 1-3.

Samples were collected, documented, and handled in accord with standard operating procedures (SOPs) as specified in the respective Sampling and Analysis Plans (SAPs). The Data Summary Report and Sampling Summary Report (CDM, 2007a and CDM, 2008) provide additional details on sampling events as well as deviations from the SAPs.

Data documenting sample type, location, collection method, and collection date were recorded both in a field log book maintained by the field sampling team and on a field sample data sheet (FSDS) designed to facilitate data entry into the Libby site database, as described in Section 4.1. All samples collected in the field were maintained under chain of custody during sample handling, preparation, shipment, and analysis.

3.1.1 Air Samples

All air samples were collected by drawing a sample through a filter that traps asbestos and other particulate material on the face of the filter. Two main categories of air samples were collected:

1. Personal Air Samples - Sampling equipment worn by a person or affixed to a piece of operating equipment/vehicle. Samples collected both indoors and outdoors.
2. Stationary Air Samples - Sampling equipment placed on motionless surface. Samples collected both indoors and outdoors.

Personal air sampling involved a variety of activities performed by the sampler with and without operating equipment/vehicle. These activities may have been scripted or unscripted. Scripted activities required the sampler and/or equipment to perform a written script. Unscripted activities are those for which a formal written script was not used. For example; a scripted activity might involve a sampler performing specific office work routine while wearing a sampling pump and filter cassette in a building with current use as an office. An unscripted activity might involve the sample equipment worn by a site worker going about his/her self-determined routine.

Unscripted personal air data was most frequently collected in association with Occupational Safety and Health Administration (OSHA) exposure monitoring for workers on OU5. These data were not intended for use in site characterization or for estimation of residual risks to current or future populations at OU5.

Stationary sampling included sampling of ambient air at OU5 but also included sampling proximal to a person or piece of equipment conducting scripted activities. Scripted stationary air samples were collected to represent conditions in the breathing zone as a surrogate for a personal air sample.

Such sampling was conducted at a variety of locations including but not limited to:

- Unoccupied buildings while disturbing the dust with a leaf-blower or equivalent.
- Proximal to stadium seating at the MotoX Park during a race.

Inhalation of air is considered to be the most direct route of exposure to LA and is therefore the primary medium of concern. Scripted air sampling activities were determined to provide the most meaningful measure of human exposure to LA at OU5 (EPA, 2008a). Such scripted sampling is referred to in the remainder of this report as Activity-Based Sampling (ABS).

All ABS events were conducted in accord with EPA's Emergency Response Team (ERT) SOP #2084 (Activity-Based Air Sampling for Asbestos), with project-specific modifications.

Activity-Based Sampling was conducted to evaluate possible exposure of a variety of populations at OU5 including commercial/industrial workers, maintenance workers and recreational visitors. Activity-Based Sampling was conducted at locations shown on Figure 3-1 to target the following populations at OU5:

- Visitors participating in and viewing MotoX activities at the MotoX Park (EPA, 2008b)
- Visitors riding a bicycle on the bike path along Libby Creek (EPA, 2008c)
- Workers engaging in outdoor activities at various locations on OU5 (EPA, 2008d; CDM, 2007)
- Workers engaging in indoor activities in various buildings on OU5 (EPA, 2007a)

Activities include raking, operating machinery, riding a bike or motorcycle, moving waste bark and active and passive indoor worker activities. The intent was to disturb LA containing materials (ie. soil or dust) by performing an activity typical for a given building or outdoor location allowing measurement of actual LA exposure for that activity.

A detailed description of the study design and data quality objectives (DQOs) for each ABS study is provided in the respective SAPs, cited above.

As part of the OU5 outdoor worker ABS investigation, sampling was conducted at eight ABS areas (Figure 3-1) (EPA 2008d). Each ABS area was approximately 1-1.5 acres in size. These eight ABS areas were selected based on previous visible vermiculite sampling results to represent the range of expected soil contamination conditions at the OU5 site.

All outdoor ABS air sampling was performed in September or October in order to make measurements during the time of year where conditions are drier than most other months.

3.1.2 Dust Samples

Indoor dust samples were collected as part of four different sampling programs; Phase 1 investigation in May 2002, Contaminant Screening Study in September 2002, Pre-Design Inspection for the Central Maintenance Building in April 2004 (CDM, 2007a), and Building Data Gap Sample Collection (EPA, 2007a).

Dust samples were collected from horizontal surfaces such as a shelf or floor inside buildings. Samples were collected using a microvacuum dust filter that was operated for between two and five minutes. Each sample was a composite consisting of up to ten, 100-square centimeter (cm²) areas.

These data were primarily used to assess whether an occupied building should be considered for emergency cleanup. As discussed in Section 5.3, several buildings contained dust above the action threshold of 5,000 LA structures per cm² (s/cm²).

As discussed in Section 3.1.1 and 5.2, ABS was conducted in occupied and vacant buildings, including buildings previously subjected to cleaning of interior surfaces and/or removal of LA-containing building materials (e.g. vermiculite insulation). Results of indoor ABS are discussed in Sections 5.2 and 5.3.

3.1.3 Soil Samples

Surface Soil

Most soil sampling at OU5 involved surface soils. Soil sampling at OU5 began in 2002 with an initial phase that included systematic sampling across most of OU5 as well as a focused investigation of four specific areas of interest including:

- Soils near the Central Maintenance Building
- MotoX Park
- A proposed demolition derby track
- Former Tree Nursery area.

At least multiple additional sampling events occurred after the initial 2002 event in order to gain a more complete understanding of the occurrence of LA and/or vermiculite in soil (Table 3-1). Reasons for additional sampling included areas not originally sampled, areas known to have vermiculite containing materials and areas of high use. A discussion of soil sample strategies is provided in:

- Data Summary Report, Operable Unit 5 – Former Stimson Lumber Company, Libby Asbestos Site, Libby, MT (CDM. 2007a).
- Sampling Summary Report, 2007 Investigations, Operable Unit 5 – Former Stimson Lumber Company, Libby Asbestos Site, Libby, MT (CDM. 2008).

Soil samples included grab and composite samples. Grab samples were collected as a shallow core approximately 2 inches in diameter and no more than 6 inches bgs. Composites were comprised of between two and thirty grab samples. In some cases, the individual grab samples were analyzed along with the composite.

Figure 3-1 shows locations of all surface soil samples (grab or composite) that were collected and analyzed (or otherwise examined). The variability in sample density apparent on this figure relates to the various strategies employed to characterize surface soils at OU5 during period of field investigations (2002-2009).

An initial, roughly systematic sampling event was intended to provide general coverage of OU5. Sample spacing of this initial event is apparent in the west-central portion of OU5 (Figure 3-1). This initial investigation omitted the LG Site, which was later subject to additional, relatively dense systematic sampling as shown on the figure.

Subsequent localized investigations of surface soil focused on specific areas where vermiculite (and therefore, associated LA) was either observed or otherwise suspected to be present based on historical land use (e.g., former vermiculite popping plant).

In addition, locations with current or proposed high-use recreational lands were also the target of stand-alone investigations. These included the MotoX Park (Figure 3-1) and a proposed demolition derby (proximal to the MotoX Park).

Prior to selecting the locations for Outdoor Worker ABS events, all existing OU5 surface soil data were examined to discern trends in spatial variability of LA or vermiculite occurrence. The purpose of this exercise was to allow selection of Outdoor Worker ABS locations that represented a range of surface soil contamination.

Ultimately, outdoor worker ABS areas were selected based on visual vermiculite inspection results. Previous sampling activities characterized vermiculite levels throughout most of OU5 based on visual inspection, and this information was used to categorize the level of vermiculite in the soil as None, Low, Moderate or High based on relative scoring (See Section 3.2.2). Outdoor Worker ABS areas were selected to include two areas from each category. Table 3-2 shows the visible inspection scores at the selected locations for the Outdoor Worker Exposure ABS. Outdoor Worker ABS locations are shown on Figure 3-1.

Once outdoor ABS locations were selected (for worker and recreational land uses), those areas were subject to additional surface soil sampling (as shown on Figure 3-1). All ABS areas were characterized by collecting and analyzing at least 30 individual grab samples and then also analyzing a 30-point composite sample comprised of the grabs. Most samples were analyzed to determine presence of LA. Analytical methods are discussed in Section 3.2.2.

The purpose of this additional sampling was three-fold:

- Verify that outdoor worker ABS areas did represent a range of LA levels and visible vermiculite conditions.
- Produce data that could be used to develop a mathematical relationship between LA occurrence in soil and in air.
- Evaluate whether composite sampling of OU5 soils is masking variability of LA occurrence in grab samples.

Subsurface Soil

Subsurface samples were collected in limited areas. Generally, these areas were selected based on the location of suspected buried LA containing materials including the former Popping Plant and a buried railroad spur (Figure 1-3). Sampling at these locations as well as a few scattered locations across OU5 included composites consisting of five grab samples collected from depths of 40 to 60 inches bgs. Additional subsurface grab samples were collected as part of the LG Site investigation in 2007. These samples were collected from depths of 12-15 inches bgs.

3.1.4 Waste Bark

Waste bark is stored on OU5 in stockpiles (see Figure 1-3). On October 15, 2007, bulk waste bark debris samples were collected to test for a presence of LA and to evaluate removal options and potential future uses.

Waste bark piles were split into 100 ft by 100 ft grids. Sampling was conducted using a test pit method in each grid. A total of 27 bulk material samples and one field duplicate were collected from the top, middle and bottom section of each waste bark test pit. Of these 27 samples, 19 field samples and one field duplicate were analyzed. The remaining samples may be analyzed at a later date, as directed by the EPA (CDM, 2008).

3.2 SAMPLE PREPARATION AND ANALYSIS

A detailed description of the number of samples analyzed from each sampling event, sampling and analytical methods used and detection results is provided in Appendix B. A thorough description of sample preparation and analytical methodology is also provided in Appendix C and summarized below.

3.2.1 Air and Dust

In the past, the most common technique for measuring asbestos in air was phase contrast microscopy (PCM). In this technique, air is drawn through a filter and airborne particles become deposited on the face of the filter. All structures that have a length greater than 5 micrometers (um) and have an aspect ratio (the ratio of length to width) of 3:1 or more are counted as PCM fibers. The limit of resolution of PCM is about 0.25 um, so particles thinner than this are generally not observable.

A key limitation of PCM is that particle discrimination is based only on size and shape. Because of this, it is not possible to classify asbestos particles by mineral type, or even to distinguish between asbestos and non-asbestos particles. For this reason, nearly all samples of air collected in Libby are analyzed by transmission electron microscopy (TEM).

This method operates at higher magnification (typically about 20,000x) and hence is able to detect structures much smaller than can be seen by PCM. In addition, TEM instruments are fitted with accessories that allow each particle to be classified according to mineral type.

If air samples were not deemed to be overloaded by particulates¹, filters are directly prepared for analysis by TEM in accord with preparation methods provided in International Organization for Standardization (ISO) 10312 (ISO, 1995).

¹ Overloaded is defined as >25% obscuration on the majority of the grid openings (see Libby Laboratory Modification #LB-000016 and SOP EPA-LIBBY-08).

If air samples are deemed to be overloaded, samples are prepared indirectly in accord with procedures in SOP EPA-LIBBY-08. In brief, rinsate or ashed residue from the original filter is suspended in water and sonicated. An aliquot of this water is applied to a second filter which is then used to prepare a set of TEM grids. Reported air concentrations for indirectly prepared samples incorporate a dilution factor.

Air and dust samples collected as part of the OU5 sampling programs were analyzed by TEM in basic accord with counting and recording rules specified in ISO 10312, and project-specific counting rule modifications specified in the respective SAPs. These modifications included changing the recording rule to include structures with an aspect ratio $\geq 3:1$.

For each countable structure particle identified, the analyst records structure-specific information (e.g., length, width, asbestos mineral type) which is then used to calculate air concentration in LA structures per cubic centimeter (s/cc) or dust loading in s/cm^2 .

3.2.2 Soil and Bulk Material

Polarized Light Microscopy (PLM)

Soil samples collected as part of the OU5 sampling programs were prepared for analysis in accord with SOP ISSI-LIBBY-01 as specified in the CDM Close Support Facility (CSF) Soil Preparation Plan (CDM, 2004). In brief, each soil sample is dried and sieved through a ¼ inch screen. Particles retained on the screen (if any) are referred to as “coarse” fraction. Particles passing through the screen are referred to as fine fraction, and this fraction is ground by passing it through a plate grinder. Resulting material is referred to as “fine ground” fraction. The fine ground fraction is split into four equal aliquots; one aliquot is submitted for analysis and the remaining aliquots are archived at the CSF.

Soil samples are analyzed using PLM by visual estimation (PLM-VE) whereby the analyst visually estimates the amount of asbestos in the sample (expressed as percent by weight) based on comparison to reference materials.

The coarse fractions were examined using stereomicroscopy, and any particles of asbestos (confirmed by PLM) were removed and weighed in accord with SRC-LIBBY-01 (referred to as “PLM-Grav”). Fine ground aliquots were analyzed using a Libby-specific PLM method using visual area estimation, as detailed in SOP SRC-LIBBY-03. For convenience, this method is referred to as “PLM-VE.”

PLM-VE is a semi-quantitative method that utilizes site-specific LA reference materials to allow assignment of fine ground samples into one of four “bins,” as follows:

- *Bin A (ND)*: non-detect
- *Bin B1 (Trace)*: detected at levels lower than the 0.2% LA reference material

- *Bin B2 (<1%)*: detected at levels lower than the 1% LA reference material but higher than the 0.2% LA reference material
- *Bin C*: LA detected at levels greater than or equal to the 1% LA reference material

Visual Inspection

For soil samples, field teams also provide a semi-quantitative estimate of visible vermiculite present at soil sampling point(s). Visual inspection data can be used to characterize the level of vermiculite (and presumptive LA contamination) in an area and considers both frequency and level of vermiculite. This is achieved by assigning a weighting factor to each level, where weighting factors are intended to represent relative levels of vermiculite in each category. As presented in SOP CDM-LIBBY-06, guidelines for assigning levels are as follows:

- None – No flakes of vermiculite observed within the soil sample.
- Low – A maximum of a few flakes of vermiculite observed within the soil sample.
- Moderate – Vermiculite easily observed throughout the soil sample, including the surface and contains <50% vermiculite.
- High – Vermiculite easily observed throughout the soil sample, including the surface and contains 50% or more vermiculite.

Based on these descriptions, weighting factors used to characterize magnitude of LA occurrence in soil are as follows:

Visible Vermiculite Level (L_i)	Weighting factor (W_i)
None	0
Low	1
Moderate	3
High	10

The composite score is then the weighted sum of the observations for the area:

$$Score = \frac{\sum_{i=1}^{30} L_i * W_i}{30}$$

This value can range from zero (all 30 points are “none”) to a maximum of 10 (all 30 points are “high”). For example, an ABS area with 1 “low” point and 29 “none” points would receive a value of $1/30 = 0.033$, while an ABS area with 24 “intermediate” points and 5 “high” would receive a score of $(24 \cdot 3 + 5 \cdot 10) / 30 = 4.13$.

In addition to the visual estimation method described above, field crews used a less sophisticated technique prior to implementation of SOP CDM-LIBBY-06 in 2006. This involved noting in the field the simple presence or absence of visible vermiculite in soil samples.

3.2.3 Waste Bark

Waste bark samples were analyzed by adding a sample of test material to water, shaking, and allowing the sample to separate into “sinks” (mineral particles that settle to the bottom), “floats” (particles of wood that rise to the top), or “suspended” (particles that remain in the water). The “sinks” are collected, dried, and analyzed using EPA-Libby-10, Analysis of Waste Bark and Wood Chip Samples for Fibrous Amphibole, a qualitative analysis method utilizing PLM and TEM. If no fibrous amphibole is detected in the “sinks”, then a sample of the water is analyzed by TEM for suspended amphibole. If fibrous amphibole is detected in either fraction, the sample is reported as “detect”. If fibrous amphibole is detected in neither fraction, the sample is reported as “non-detect”.

4.0 DATA RECORDING, DATA QUALITY ASSESSMENT, AND DATA SELECTION

4.1 DATA RECORDING

All analytical results are stored and maintained in the Libby 2 Database (Libby2DB) and more recently the Libby Data Warehouse. Appendix D1 provides an electronic copy of the database.

Detailed summaries of sample results for environmental media collected in OU5 through 2007 are provided in CDM (2007a) and CDM (2008). Standardized data entry spreadsheets (electronic data deliverables or EDDs) have been developed specifically for the Libby project to ensure consistency between laboratories in the presentation and submittal of analytical data. In general, a unique EDD has been developed for each type of analytical method. Each EDD provides the analyst with a standardized laboratory bench sheet and accompanying data entry form for recording analytical data. Data entry forms contain a variety of built-in quality control functions that improve accuracy of data entry and help maintain data integrity. These spreadsheets also perform automatic computations of analytical input parameters (e.g., sensitivity, dilution factors, and concentration), thus reducing the likelihood of analyst calculation errors. The EDDs generated by the laboratories are uploaded directly into the Libby site database.

Hard copies of all FSDSs, field log books, and chain of custody forms generated during the various OU5 sampling program are stored in the CDM field office in Libby, Montana.

Hard copies of all analytical bench sheets are included in analytical laboratory reports. These analytical reports are submitted to the Libby Laboratory Coordinator and stored at CDM offices in Denver, CO.

Historically, sample and analytical electronic data were stored and maintained in the Libby2DB which was housed on a structured query language (SQL) server at EPA Region 8 in Denver, Colorado. At the time of this report, EPA was in the process of transitioning to a new data management system, referred to as Scribe.net. In the future, sample and analytical electronic data will be stored and maintained in the Libby Data Warehouse which is populated by Scribe.net and housed on the EPA network.

4.2 DATA QUALITY ASSESSMENT

Data quality assessment (DQA) is the process of reviewing existing data to establish the quality of the data and to determine how any data quality limitations may influence data interpretation (EPA, 2006). The full DQA is provided as Appendix E.

For the purposes of the risk assessment (Section 7), the principle datasets utilized to quantify potential exposures are the air samples collected during the various ABS programs at OU5.

In addition, soil data (both visible vermiculite inspection results and PLM-VE results) are utilized in the interpretation of Outdoor Worker ABS results. Therefore, the DQA focuses on ABS air samples and Site-wide soil samples used to support the risk assessment.

The DQA process considered the following:

- Field and laboratory audit results.
- Field and laboratory quality control sample results.
- Data entry verification.
- Comparison of data collected with specified DQOs stated in the respective ABS SAPs.

Results of the DQA indicate that air and soil data collected at OU5 and utilized in the risk assessment generally are of acceptable quality, adequate and representative, and considered to be reliable and appropriate for use in the RI including the risk assessment.

4.3 DATA SELECTION

Raw data for samples utilized in describing the occurrence of LA in OU5 soils and air (Section 5) were obtained via a subscription to the Libby OU5 project database through Scribe.net. A copy of this database was obtained by SRC, Inc. on March 12, 2010, and is provided electronically in Appendix D1 of this report.

Because all data had not yet been migrated from Libby2DB to Scribe.net at the time of this report (e.g., quality control samples and analyses, air pump information, etc.), data were supplemented by results from the Libby2DB. The Libby2DB was downloaded into a Microsoft Access[®] database by SRC, Inc. on December 8, 2009. Note that any changes made to these databases since they were obtained/download will not be reflected in Appendix D1.

In addition, supplemental GPS coordinate data for historical soil samples were provided by CDM on March 25, 2010. An Microsoft Excel[®] spreadsheet summarizing these coordinate data is provided in Appendix D1.

Scribe queries were written to sort data by media, analytical method and to exclude quality control samples. The Scribe queries for soil and air samples are provided in Appendix D2. The data set resulting from execution of the queries was used to describe the nature and extent of LA occurrence.

5.0 NATURE AND EXTENT OF LA

5.1 CONTAMINANTS OF CONCERN

The contaminant of concern at the Libby Site is asbestos. Asbestos is the generic name for the fibrous form of a broad family of naturally occurring poly-silicate minerals. Based on crystal structure, asbestos minerals are usually divided into two groups - serpentine and amphibole.

- Serpentine - The only asbestos mineral in the serpentine group is chrysotile. Chrysotile is the most widely used form of asbestos, accounting for about 90% of the asbestos used in commercial products (IARC, 1977). There is no evidence that chrysotile occurs in the Libby vermiculite deposit, although it may be present in some types of building materials in Libby.
- Amphibole – Five minerals in the amphibole group that occur in the asbestiform morphology have found limited use in commercial products (IARC, 1977), including actinolite, amosite, anthophyllite, crocidolite, and tremolite.

At the Libby Site, the form of asbestos that is present in the vermiculite deposit is amphibole asbestos that for many years was classified as tremolite/actinolite (e.g., McDonald et al., 1986a, Amandus and Wheeler, 1987). More recently, the U.S. Geological Service (USGS) performed electron probe micro-analysis and X-ray diffraction analysis of 30 samples obtained from asbestos veins at the mine (Meeker et al., 2003). Using mineralogical naming rules recommended by Leake et al. (1997), the results indicate that asbestos at Libby includes a number of related amphibole types. The most common forms are winchite and richterite, with lower levels of tremolite, magnesioriebeckite and possibly actinolite.

Because mineralogical name changes that have occurred over the years do not alter the asbestos material that is present in Libby, and because EPA does not find that there are toxicological data to distinguish differences in toxicity among these different forms, the EPA does not believe that it is important to attempt to distinguish among these various amphibole types. Therefore, EPA simply refers to the mixture as (LA).

5.2 LA IN AIR

The amount of LA fibers released to air will vary depending upon the level of LA in the source material (e.g., outdoor soil, indoor dust) and the intensity and duration of the disturbance activity. Because of this, predicting the LA levels in air associated with disturbance activities based only on measured LA levels in the source material is extremely difficult. Therefore, ABS is considered to be the most direct way to estimate potential exposures from inhalation of asbestos. ABS results for indoor and outdoor air are summarized on Figures 5-1 and 5-2, respectively.

Indoor Air

Figure 5-1 summarizes ABS results for existing buildings except those that have fewer than four walls or have a dirt floor. In addition, no ABS air data is available for the Finger Jointer Process Plant.

Samples from most vacant buildings contained no detectable LA. Samples from most occupied buildings contained detectable LA. For buildings where LA was detected, the mean concentration varied by a factor of 1,000.

Outdoor Air

Figure 5-2 summarizes results for the eight Outdoor Worker ABS locations and ABS conducted along the bicycle path and at the MotoX Park. LA was detected in seven of the eight Outdoor Worker ABS areas. The mean LA concentration varied by a factor of 10 across the seven areas where LA was detected.

Sampling at the MotoX Park included stationary samplers proximal to the location of spectators as well as samplers fixed to handlebars of dirtbikes. No LA fibers were detected in any sample.

Sampling was conducted separately for paved and unpaved portions of the bike path. On the paved path, a stationary air monitor was also mounted in a trailer attachment to one of the bicycles to characterize potential exposures to a young child being pulled by a parent. Samples from the trailer were not collected from the unpaved portion of the path because the unpaved portion of the path is steep and narrow in sections, and is not safe for pulling a trailer. The mean LA concentrations for the adult and child were similar.

5.3 LA IN DUST

Figure 5-3 illustrates buildings that have been sampled for indoor dust and presents the total LA dust loading results relative to the current EPA removal action level for indoor dust ($> 5,000$ total LA s/cm^2 ; EPA, 2003).

Of the 87 indoor dust field samples collected, 28 samples had detectable levels of LA, with detectable levels ranging from 35 to 44,116 total LA s/cm^2 . Only four samples had detectable levels of LA above the current EPA removal action level:

- Former Tree Nursery area shed – Total LA dust loading was 7,026 s/cm^2 for one composite sample collected in May 2002 from sampling locations atop wood piles and from a ground level beam in this shed. This building was no longer present during the 2007 site visit (CDM, 2007a).
- Central Maintenance Building – Total LA dust loading was 8,823 s/cm^2 for one of 29 composite samples collected from this building in September 2002. This sample was

collected from two engine rooms and the main work area. The source of dust contamination in this building was likely vermiculite insulation and vermiculite-containing building materials which were subsequently removed in 2005 (CDM, 2007a).

- Diesel Fire Pump House – Total LA dust loading was 8,823 s/cm² for one composite sample collected from three areas within this building in September 2002.
- Guard Station at Libby Creek Bridge – Total LA dust loading was 44,116 s/cm² for one composite sample collected from this building in September 2002. The guard station did not contain vermiculite insulation at the time of sampling (CDM, 2007a). This building was no longer present during the 2007 site visit (CDM, 2007a).

5.4 LA IN SOIL

Surface Soil

Figure 5-4 illustrates LA occurrence in OU5 surface soils based on PLM results. A 4-color scheme is used to indicate the amount of LA present in a sample (additional detail on analytical reporting is provided in Appendix C):

- green = Bin A (non-detect)
- yellow = Bin B1 (trace)
- orange = Bin B2 (< 1%)
- red = Bin C (≥ 1%)

In this figure, individual grab samples (primarily collected within the Outdoor Worker ABS areas) are shown as triangles, and composite samples are shown as circles plotted at the mid-point of the area. Composite samples are representative of a larger area than the plotting point presented in this figure.

Figure 5-5 illustrates vermiculite occurrence in OU5 soils based on visual vermiculite inspection results. In this figure, historical observations of visible vermiculite which utilized a qualitative present/absent approach are shown as triangles.

More recent visible vermiculite observations which utilized a semi-quantitative approach are shown as squares and are color-coded based on the visible score (see Section 3.2.2). A 4-color scheme is used to indicate visible score data:

- green = score of 0 (no visible detected)
- yellow = score < 0.1
- orange = score 0.1 to < 0.3
- red = score > 0.3

One potential limitation to the approach for presenting visible score data is that the choice of cut-offs for use in color-coding is arbitrary. If other cut-offs were chosen, the appearance of the figures would be different. For example, the cutoff for red is 0.3 out of a possible score of 10. Nevertheless, the figures do provide a useful indication of the degree to which there is variation across OU5 and locations where higher than average levels have been observed.

As shown in Figure 5-4, PLM results are generally non-detect or trace across OU5. The one location where PLM results have consistently been higher (with observed LA levels up to 1%) is the north-central portion of the former Tree Nursery area. This location also has elevated visible scores (see Figure 5-5).

Differences in the more recent visual vermiculite results compared to the original results likely arises from the inherently subjective nature of the category assignments, as well as variations in site conditions between rounds (e.g., cloud cover vs. sunshine, amount of ground cover, soil moisture, etc.).

Subsurface Soil

PLM and visual inspection results for subsurface soils are presented on Figure 5-6. LA was not detected in any composite sample collected near the former Popping Plant or in other samples scattered across the remainder of OU5. LA was reported as <1% in a single composite sample collected along the railroad spur.

LA was not detected in any of the grab samples collected in the LG Site. Visible vermiculite was noted as “moderate” in a single sample. Unlike the visible vermiculite score used to describe the relative level of vermiculite in composite samples, the result for individual grab samples is expressed as none, low, moderate or high, as discussed Section 3.2.2.

These results suggest that, in the areas examined, the occurrence of LA or vermiculite does not increase with depth.

5.5 LA IN WASTE BARK

Of the 19 waste bark samples analyzed, LA was detected in 1 sample analyzed by PLM, and LA was detected in 13 samples by TEM. These results show that LA is present in these piles, but it is not possible to quantify how much LA may be present based on the qualitative method used for waste bark (See Section 3.2.3).

5.6 Supplemental Studies

As discussed in Section 3.0, several targeted investigations were performed after 2009. These included:

1. ABS air sampling during the handling of wood chips produced during historical lumber processing operations. The purpose of the investigation was to evaluate whether disturbance of the wood chips (by workers or residents) resulted in health risks above a level of concern. All of the ABS air sample results were non-detect for LA. Without fibers being detected, risks were not estimated as there was no exposure. A Memorandum summarizing the investigation and findings was prepared by CDM Smith is provided as Appendix F1.
2. Soil sampling to assess LA occurrence at the Former Tree Nursery to identify areas requiring excavation prior to design/construction of a proposed recreational fishing pond. Unpublished results indicated the presence of trace levels of LA in some of the areas sampled. Portions of the sampled areas were subsequently excavated (See Table 1-1 and Figure 1-4). A map illustrating the extent of LA in sampled areas is provided as Appendix F2.

6.0 CONTAMINANT FATE AND TRANSPORT

As discussed in Section 1.4, asbestos containing material was potentially transported to OU5 via the following activities:

- The former Popping Plant was once used as an aboveground storage area for uncontained vermiculite ore. Ore was stockpiled directly on the native soil surface in this area.
- The Railroad Spur was used for shipping raw and unprocessed vermiculite material to and from the site.
- The former Tree Nursery may have introduced raw vermiculite product into this area as a growth medium and fill material.

The fate and transport of asbestos containing fibers is dependent on the type of host media (soil, water, air, etc.), land use, and site characteristics. Asbestos fibers (both serpentine and amphibole) are indefinitely persistent in the environment. According to the Agency for Toxic Substances and Disease Registry (ATSDR):

“Asbestos fibers are nonvolatile and insoluble, so their natural tendency is to settle out of air and water, and deposit in soil or sediment (EPA 1977, 1979c). However, some fibers are sufficiently small that they can remain in suspension in both air and water and be transported long distances. For example, fibers with aerodynamic diameters of 0.1–1 μm can be carried thousands of kilometers in air (Jaenicke 1980), and transport of fibers over 75 miles has been reported in the water of Lake Superior (EPA 1979c).” In addition, *“they are resistant to heat, fire, and chemical and biological degradation”* (ATSDR, 2001).

The primary transport mechanisms for asbestos and asbestos containing material include:

- Suspension in air and transport via dispersion
- Suspension in water and transport downstream

Asbestos can become suspended in air when asbestos or asbestos containing material is disturbed. Wind, recreational activities, construction, and site work can disturb material outdoors. Indoors, asbestos can be suspended when contaminated material (usually insulation) is disturbed by cleaning, renovation or other general disruption.

Asbestos residence time in the air is determined primarily by particulate thickness; however it is influenced by other factors such as length and static charge. The average thickness of LA particles is 0.4 μm and ranges from approximately 0.1 to 1.0 μm . The suspension of LA in air is measured in “half times” which is the amount of time it will take 50% of LA particles to settle out of the air column. A particle with a thickness of 0.5 μm has a half time of approximately two hours, assuming the source of disturbance has been removed.

Larger particles will settle faster; a particle of 1 μm has a half time of about 30 minutes. Smaller LA particles may stay suspended for significantly longer. The typical half time for a 0.15 particle is close to 40 hours (CDM, 2007a)

Activity-specific testing found that the half-time of LA suspended by dropping vermiculite on the ground was about 30 minutes. LA suspended from disturbing vermiculite insulation settled within approximately 24 hours.

Once suspended, LA moves by dispersion through air. LA concentration will be highest near the source and will decrease with increasing distance. In outdoor air, wind speed will determine direction and velocity of LA particle transport. Wind can cause the rapid dispersal of LA from the source of release. In indoor air, mixing usually takes from 5 to 30 minutes, but is dependent on airflow within the building.

In water, LA particles can be transported downstream with the current. As in air, larger particles tend to settle to the bottom more rapidly than smaller particles. Settled particles may be transported downstream with sediment (CDM, 2009).

LA is insoluble and therefore transport in solution will not occur in surface water, groundwater or from soils to water. Further, as a particle, LA is not expected to be mobilized from surface or near surface soils vertically through the soil column to the water table.

7.0 HUMAN HEALTH RISK ASSESSMENT

An evaluation of potential exposures to and risks from LA will be included in the site-wide risk assessments for the Libby Asbestos Superfund Site. Site-wide risk assessments are stand-alone documents which support the feasibility study and ROD. As such, OU-specific risk assessment reports have not been developed.

The *Site-Wide Human Health Risk Assessment* will evaluate potential risks to humans from exposures to LA under a variety of different exposure scenarios, including both indoor and outdoor exposure scenarios that may occur at the Site. Potential risks will be evaluated both alone and across multiple exposure scenarios as part of a cumulative exposure assessment.

The *Site-Wide Ecological Risk Assessment* will evaluate potential risks to aquatic and terrestrial ecological receptors from exposures to LA that may be present in the environment at the Site.

Refer to the respective site-wide risk assessment reports to provide information on potential exposures and risks from LA to human and ecological receptors.

8.0 CONCLUSIONS

The RI reached the following general conclusions:

1. PLM results for surface soil samples are generally non-detect or trace across OU5. The one location where PLM results have consistently been higher (with observed LA levels up to 1%) is the former Tree Nursery area. This location also has elevated visible vermiculite scores.
2. PLM and visible vermiculite results for subsurface soil samples are generally non-detect. These results suggest that no increasing vertical gradient in LA or vermiculite occurrence exists in the areas examined. However, subsurface soil sampling across OU5 is limited.
3. Predicting the LA levels in air associated with disturbance activities based only on measured LA levels in the source material is extremely difficult. Therefore, ABS is considered to be the most direct way to estimate potential exposures from inhalation of asbestos.
4. An evaluation of potential exposures to and risks from LA will be included in the site-wide risk assessments for the Libby Asbestos Superfund Site. Site-wide risk assessments are stand-alone documents which support the field study (FS) and ROD.

9.0 REFERENCES

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Tables

TABLE 1-1
Response Actions Taken at OU5

Location (reference)	Date	Lead Agency/Company	Description
Plywood Plant and Truck Shop (CDM 2007)	November 1999	MCS Environmental through Stimson Lumber Company	Asbestos abatement
Finger Jointer (CDM 2007)	May 2000	MCS Environmental through Stimson Lumber Company	Removal of vermiculite insulation from lunch room and bathroom
Dry Kiln Tunnel (CDM 2007)	December 2002	IRS Environmental through Stimson Lumber Company	Removal of pipe insulation and asbestos containing debris
Central Maintenance Building (CDM 2007)	May/June 2003	IRS Environmental through Stimson Lumber Company	Removal of vermiculite insulation and asbestos containing materials on ground surface
Plywood Dryers (CDM 2007)	August 2003	IRS Environmental through Stimson Lumber Company	Removal of vermiculite insulation from walls, floors, and ceilings
Plywood Plant (CDM 2007)	August 2003	IRS Environmental through Stimson Lumber Company	Removal of pipe insulation of northwest corner
Screening Building (CDM 2007)	August 2003	IRS Environmental through Stimson Lumber Company	Removal of cement asbestos siding and roofing
Central Maintenance Building (CDM 2007)	December 2003	IRS Environmental through Stimson Lumber Company	Removal and repair of asbestos containing roofing material and asbestos containing materials on ground surface
Former Nursery (CDM 2007)	Fall 2004	EPA	Installation of fence to isolate area
Finger Jointer Lunch Room (CDM 2007)	February 2005	IRS Environmental through Stimson Lumber Company	Removal of vermiculite insulation
Central Maintenance Building (CDM 2007)	Summer 2005	EPA	Removal of vermiculite insulation
Soils northwest of Pipe Shop to support redevelopment (CDM 2007)	Spring and Summer 2009	EPA	Removal of LA-impacted soils to depths of 6"-18" to support Site redevelopment.
Libby Creek (OU4 action w/possible encroachment on OU5) (CDM 2007)	August 2009	EPA	Removal and replacement of rip-rap on east bank of Libby Creek
Former Plywood Plant (EPA, 2010c)	Summer 2010	EPA	Soil removal north of former veneer dryer and removal of vermiculite-containing bricks.
Valve House at Finger Joiner Building (EPA, 2010d)	Summer 2010	EPA	Removal of soil and vermiculite-containing building materials.
Central Maintenance Building (EPA, 2010e)	January 2010	EPA	Removal of vermiculite-containing insulation and interior cleaning.

TABLE 1-1 (Continued)
Response Actions Taken at OU5

Location (reference)	Date	Lead Agency/Company	Description
Former Popping Plant (EPA, 2013a)	Summer 2011	EPA	Soil removal
Central Maintenance Building (CDM Smith, 2011)	Fall 2011	EPA	Interior cleaning of areas impacted by land owner removal of asbestos-containing roof materials
Port Authority Building (CDM Offices; EPA 2012a)	Spring 2012	EPA	Soil removal associated with revegetation demonstration plot/
Former Nursery Area (EPA, 2012b)	Summer 2012	EPA	Soil removal
Central Maintenance Building (EPA, 2012c)	Fall 2012	EPA	Removal of vermiculite-containing insulation and interior cleaning.
Former Tree Nursery (EPA, 2013b)	Spring 2013	EPA	Soil Removal

Source: CDM (2007) OU5, Final Data Summary Report – October 16, 200; CDM (2012) Summary Report Memorandum and various Removal and Restoration Completion Forms (EPA or CDM, 2010-2013).

TABLE 3-1
Sampling Events at OU5

Location	Date	Investigation Description	Media Collected and Analyzed	Reason for Selecting Sample Location
Former Nursery	May 2002	Phase I Investigation	Dust	Investigative
OU5 Site-wide	September/ October 2002	Contaminant Screening Study (including building inspections)	Air, personal Air, stationary Dust Soil	Non-discriminatory grid based sampling
MotoX Track	May 2004	Soil sampling	Soil	High use area
Central Maintenance Building	April/May, August 2004	Pre-design inspection; soil, dust, and bulk insulation sampling	Soil Dust Bulk	Building contains vermiculite based materials
Proposed Demolition Derby Area	July 2004	Soil sampling	Soil	High use area
Former Nursery	June 2005	Soil and air sampling to correlate soil contamination with airborne fibers.	Air, personal Air, stationary Soil	Location was suspected to have vermiculite in soils and was therefore a suitable location.
OU5 Monitoring Station	October 2006 to September 2007	Libby ambient air monitoring	Air, stationary	Aimed to determine general background asbestos concentration levels at site
OU5 Site-wide	October 2007	Soil data gap sampling	Soil	Collect samples from areas not previously investigated.
Wood Chip/Waste Bark Piles	October 2007	Wood chip/waste bark pile sampling; outdoor worker activity-based sampling	Air, personal Soil Waste bark Wood chips	Waste bark stored on site may contain asbestos and traveled to site

Note: Excludes worker air samples collected as part of OSHA requirements that were analyzed by AHERA

Source: Based on a download of the Libby2DB performed 12/9/09

TABLE 3-1 (continued)
Sampling Events at OU5

Location	Date	Investigation Description	Media Collected and Analyzed	Reason for Selecting Sample Location
Various OU5 Buildings	November 2007 to January 2008	Indoor worker activity-based sampling	Air, personal Air, stationary Dust	Estimate LA exposure to workers
OU5 Site-wide	June/July 2008	Soil data gap addendum sampling	Air, personal Soil	Collect samples from areas not previously investigated.
MotoX Track	September 2008	Outdoor recreational activity-based sampling	Air, personal Air, stationary Soil	Estimate LA exposure to recreational users
Bicycle & Hiking Trail near Libby Creek	September 2008	Outdoor recreational activity-based sampling	Air, personal	Estimate LA exposure to recreational users
OU5 Site-wide	September/October 2008	Outdoor worker activity-based sampling	Air, personal Soil Vegetation	Estimate LA exposure to workers
Landfarm	October 2008	Landfarm soil sampling	Soil	Area of Groundwater Superfund Site not previously sampled
OU5 Re-development Zones	April 2009	Re-development soil sampling	Soil	EPA requested to do re-development plans
Libby Creek Driveway	April 2009	Pre-design inspection; soil	Soil	EPA requested to do re-development plans
Wood Chip Piles	August 2011	Outdoor activity-based sampling	Air, personal	Estimate LA exposure to individuals who disturb wood chips.
Proposed fishing pond location	June 2012	Pre-design soil sampling	Soil	Assessment prior to design/construction of proposed fishing pond.

Note: Excludes worker air samples collected as part of OSHA requirements that were analyzed by AHERA

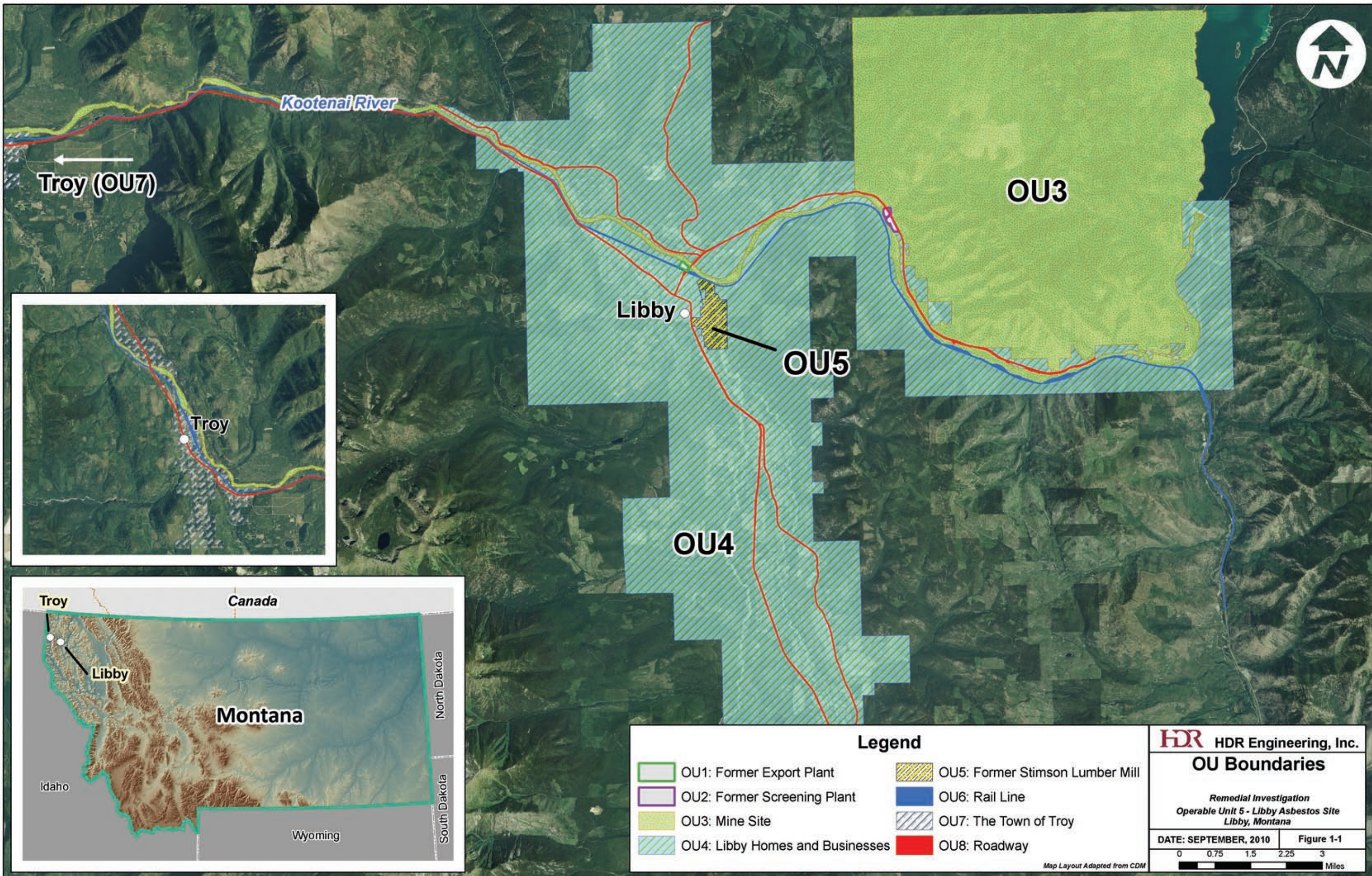
Source: Based on a download of the Libby2DB performed 12/9/09; CDM Smith 2012 and EPA 2013b

TABLE 3-2
Visible Vermiculite Inspection Scores and Selected Locations for Outdoor Worker ABS

Area	Visible Inspection Results				Score	Category
	None	Low	Med	High		
1	30				0.00	None
2	30				0.00	None
3	28	2			0.07	Low
4	28	2			0.07	Low
5	26	4			0.13	Medium
6	26	4			0.13	Medium
7	21	8	1		0.37	High
8	6	20	3	1	1.30	High

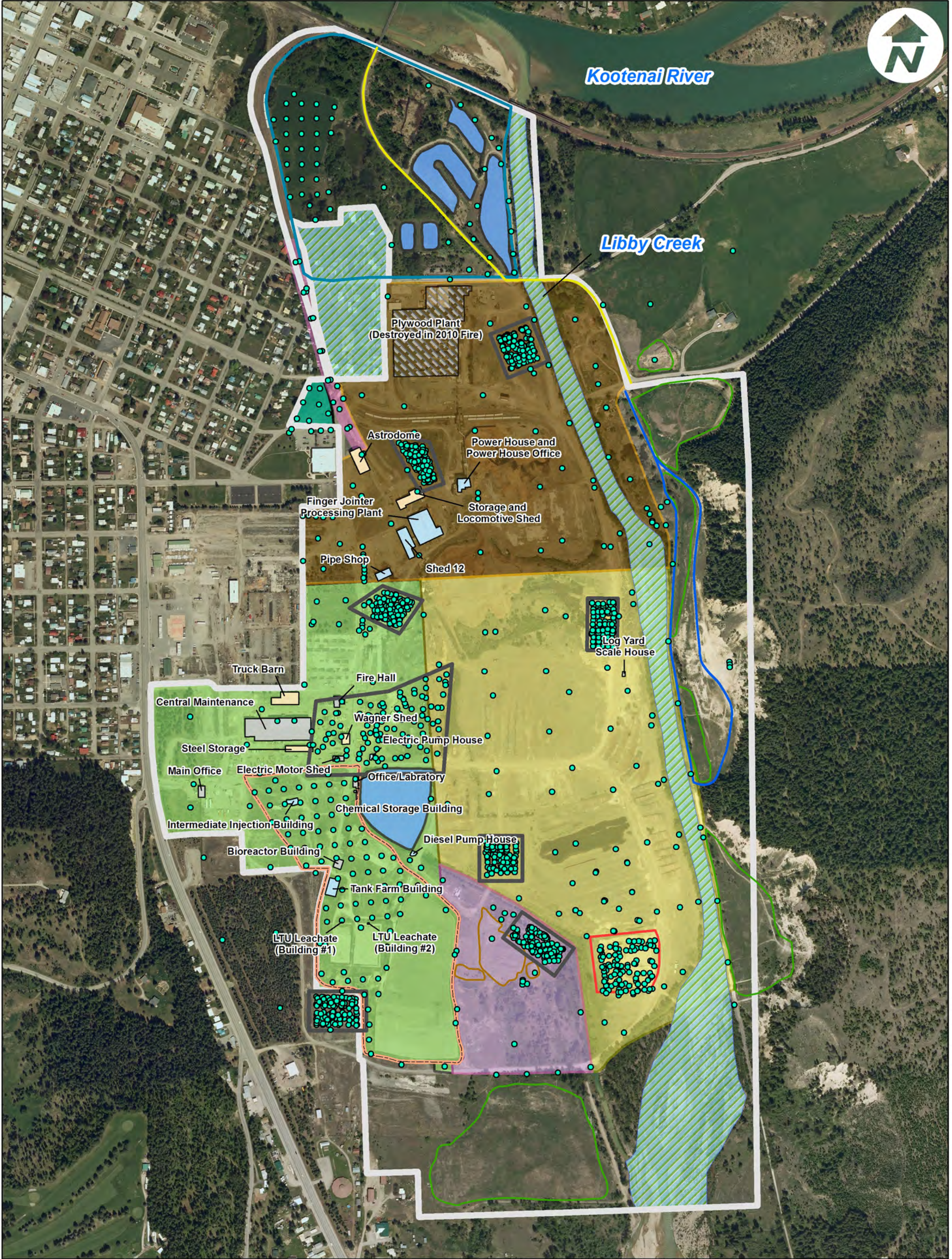
See figure 3.2 for ABS Area Locations

Figures









Legend

- | | |
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| <ul style="list-style-type: none">● Surface Soil Sampling Locations— Bike Path (Unpaved or Partially Paved)— Bike Path (Paved, as of Sept. '10)□ Storm Water Containment and Waste Water Lagoon Area□ Waste Bark Piles Debris□ Approved Waste Bark Disposal Area□ MotoX Track□ Libby Groundwater Superfund Site□ Worker ABS Areas□ OU5 Boundary□ OU4 (limits are approximately in vicinity of Libby Creek) | <ul style="list-style-type: none">□ Surface Water□ Buildings - Occupied□ Buildings - Vacant (Existing Buildings as of May 2013)□ Buildings - Open Air (less than four walls)□ Railroad Spur□ Former Popping Plant□ Lumber Yard□ Former Champion Int. Tree Nursery□ Log Storage Area□ Southwest Area |
|--|--|

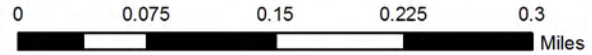
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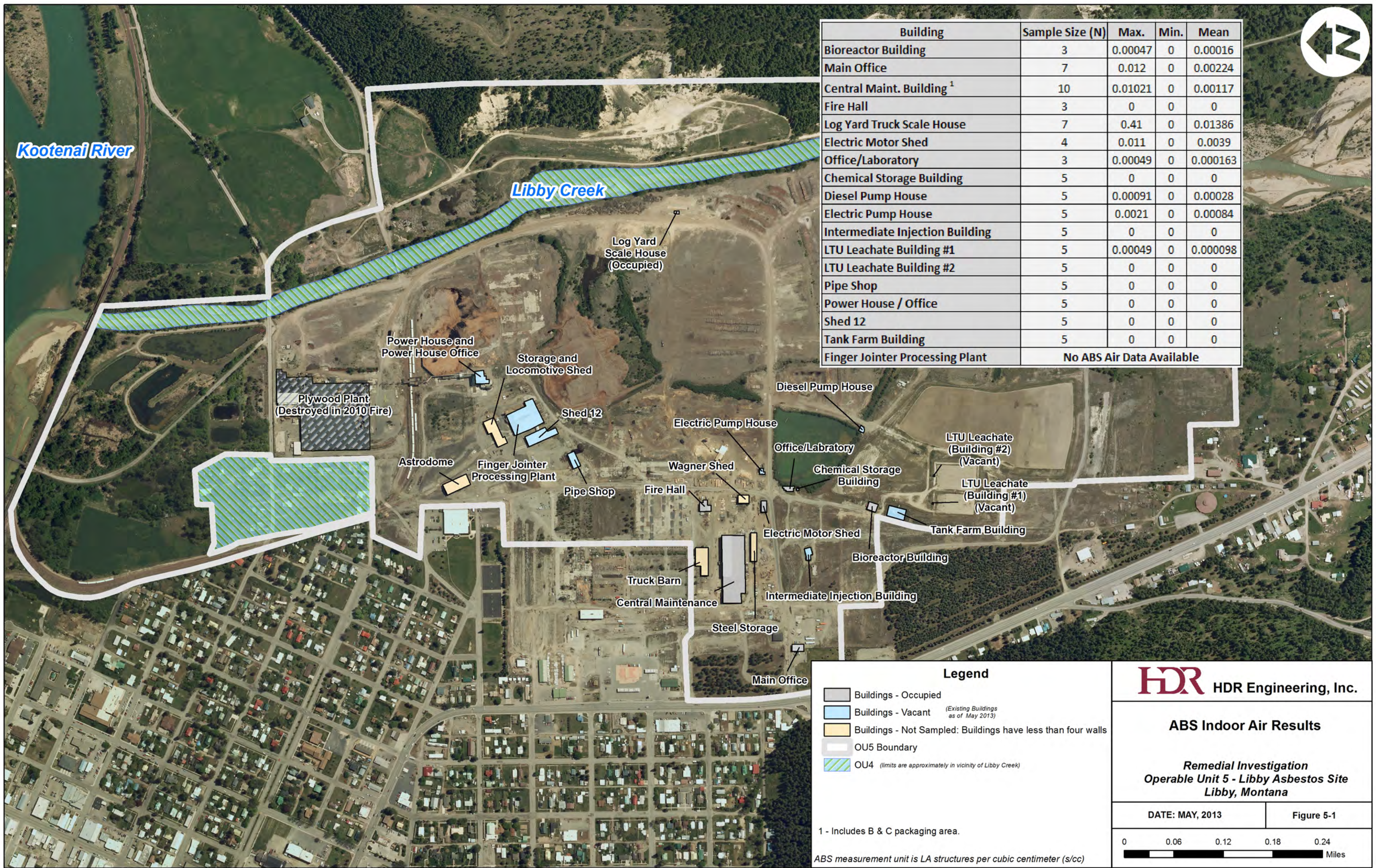
Surface Soil Sampling Locations

Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana

DATE: MAY, 2013

Figure 3-1






Building	Sample Size (N)	Max.	Min.	Mean
Bioreactor Building	3	0.00047	0	0.00016
Main Office	7	0.012	0	0.00224
Central Maint. Building ¹	10	0.01021	0	0.00117
Fire Hall	3	0	0	0
Log Yard Truck Scale House	7	0.41	0	0.01386
Electric Motor Shed	4	0.011	0	0.0039
Office/Laboratory	3	0.00049	0	0.000163
Chemical Storage Building	5	0	0	0
Diesel Pump House	5	0.00091	0	0.00028
Electric Pump House	5	0.0021	0	0.00084
Intermediate Injection Building	5	0	0	0
LTU Leachate Building #1	5	0.00049	0	0.000098
LTU Leachate Building #2	5	0	0	0
Pipe Shop	5	0	0	0
Power House / Office	5	0	0	0
Shed 12	5	0	0	0
Tank Farm Building	5	0	0	0
Finger Jointer Processing Plant	No ABS Air Data Available			

Legend

- Buildings - Occupied
- Buildings - Vacant (Existing Buildings as of May 2013)
- Buildings - Not Sampled: Buildings have less than four walls
- OU5 Boundary
- OU4 (limits are approximately in vicinity of Libby Creek)

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ABS Indoor Air Results

Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana

DATE: MAY, 2013

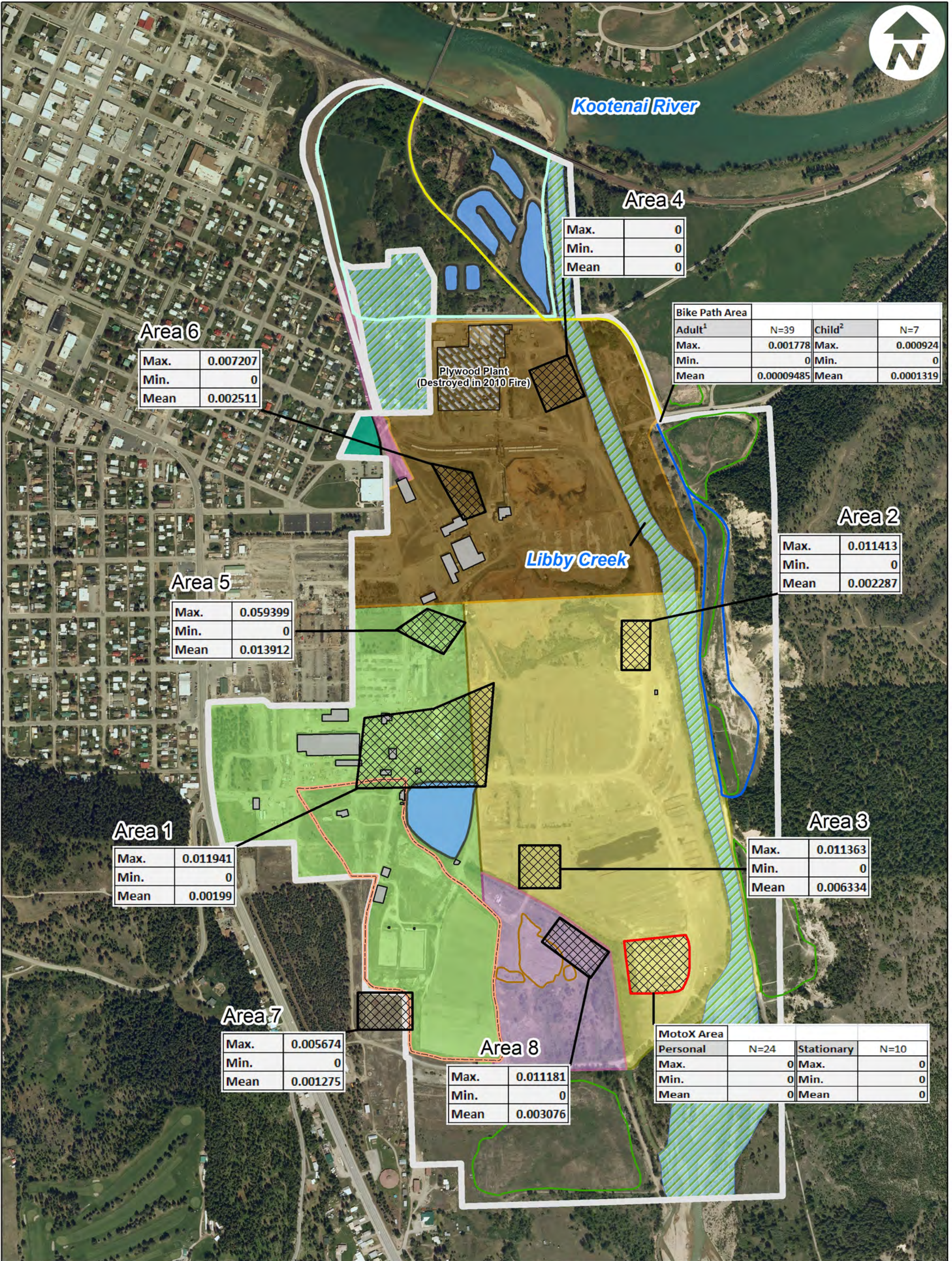
Figure 5-1

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Miles

1 - Includes B & C packaging area.

ABS measurement unit is LA structures per cubic centimeter (s/cc)



ABS Outdoor Air Testing Sites*

Bike Path (Unpaved or Partially Paved)

Bike Path (Paved, as of Sept. '10)

Worker ABS Areas (N = 6)

MotoX Track

Storm Water Containment and Waste Water Lagoon Area

Waste Bark Piles Debris

Approved Waste Bark Disposal Area

Libby Groundwater Superfund Site

OU5 Boundary

OU4 (limits are approximately in vicinity of Libby Creek)

Buildings (Existing Buildings as of May 2013)

Surface Water

Railroad Spur

Former Popping Plant

Lumber Yard

Former Champion Int. Tree Nursery

Log Storage Area

Southwest Area

Note: * ABS Measurement Unit: LA structures per cubic centimeter (s/cc)

¹ "Adult" personal air samples were collected while riding a bicycle on both the paved and unpaved portions of the bicycle path.

² "Child" personal air samples were collected via an air monitor placed in a trailer attachment to a bicycle. "Child" personal air samples were collected only on the paved portion of the bike path.

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ABS Outdoor Air Results

Remedial Investigation

Operable Unit 5 - Libby Asbestos Site

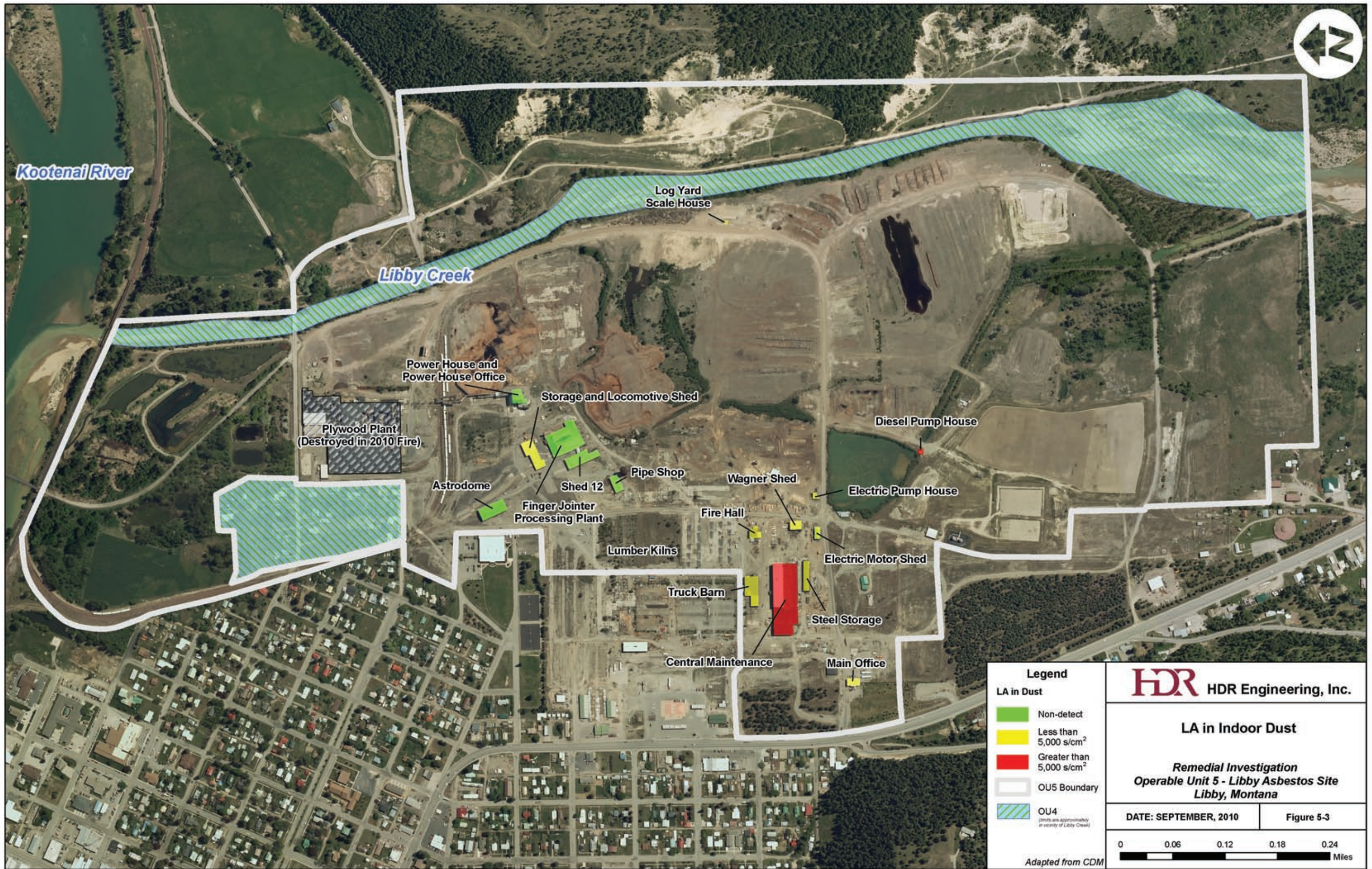
Libby, Montana

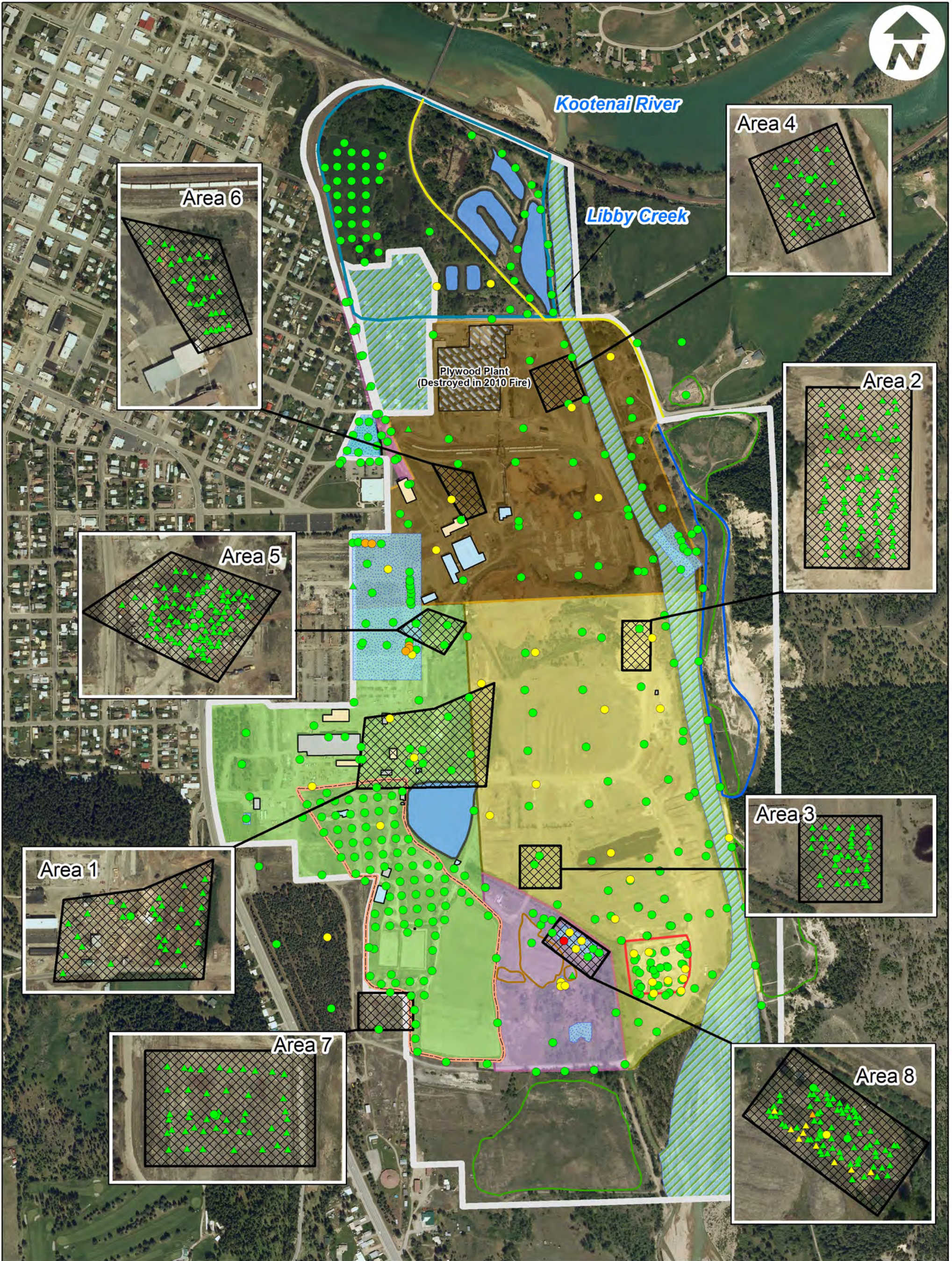
DATE: MAY, 2013

Figure 5-2

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Miles





LA Results

Grab Samples

- ▲ < 1%
- ▲ Trace
- ▲ Non-Detect

Composite Samples

- ≥ 1%
- < 1%
- Trace
- Non-Detect

- Bike Path (Unpaved or Partially Paved)
- Bike Path (Paved, as of Sept. '10)
- Storm Water Containment and Waste Water Lagoon Area
- Waste Bark Piles Debris
- Approved Waste Bark Disposal Area
- MotoX Track
- Libby Groundwater Superfund Site
- Worker ABS Areas
- OU5 Boundary
- OU4 (limits are approximately in vicinity of Libby Creek)
- Abatement Response Action Areas¹

- Buildings - Occupied
- Buildings - Vacant (Existing Buildings as of May 2013)
- Buildings - Open Air (less than four walls)
- Surface Water
- Railroad Spur
- Former Popping Plant
- Lumber Yard
- Former Champion Int. Tree Nursery
- Log Storage Area
- Southwest Area

¹Results shown on Figure reflect testing done before abatement actions. See Figure 1-4 & Table 1-1 for details on response actions taken at OU5.

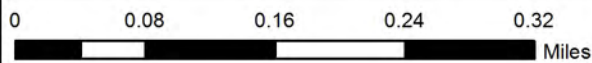
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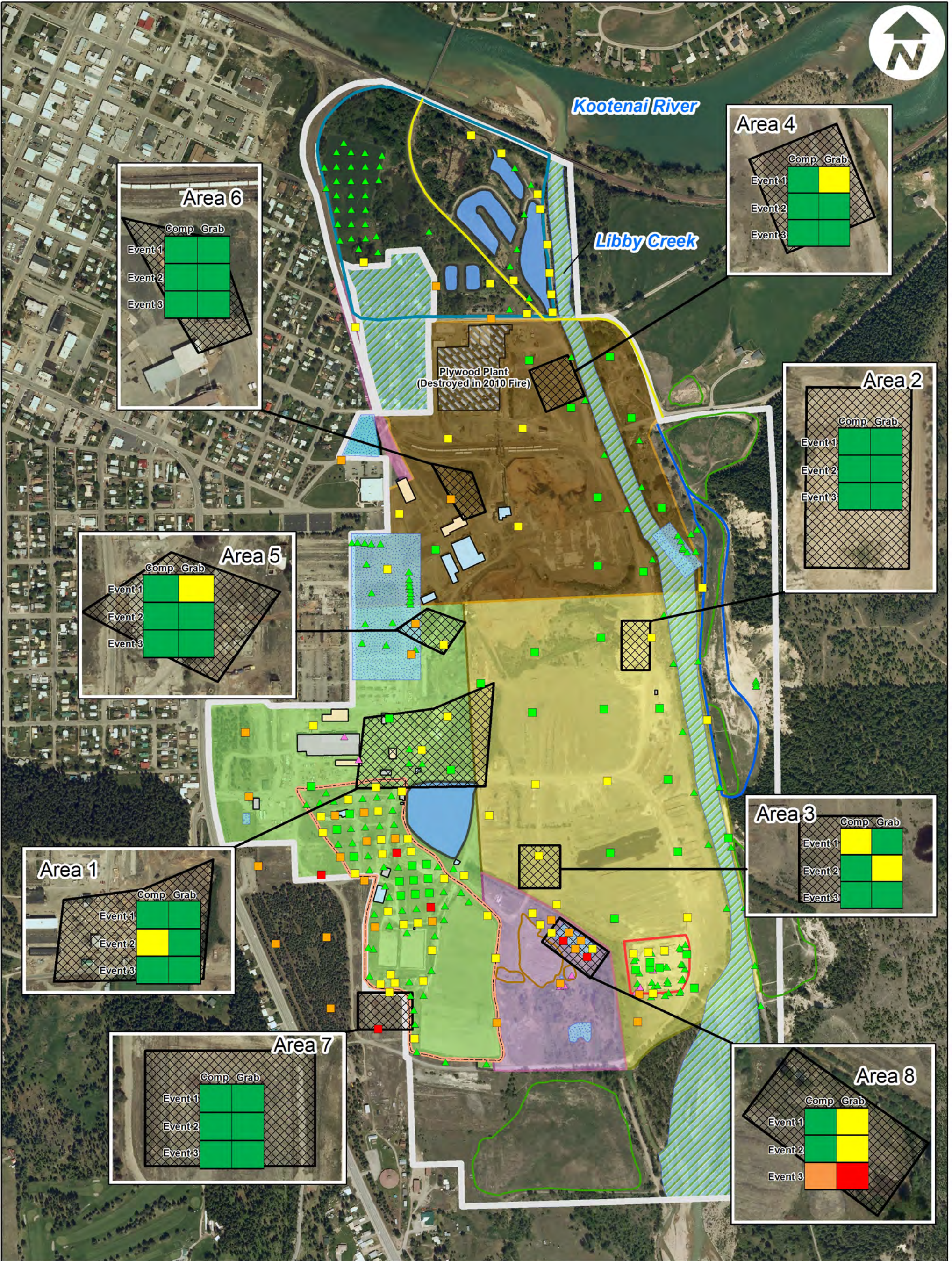
LA in Surface Soil - PLM Results

Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana

DATE: MAY, 2013

Figure 5-4





Visible Vermiculite Results

Composite Score

> 0.3 - 0.5

> 0.1 - 0.3

<= 0.1

0 (Non-Detect)

Qualitative Status (Grab & Comp.)

VIS +

VIS -

ABS Score

Note: The ABS results matrix presents the visible vermiculite scores for the three 30-point composite samples and the three sets of 30 grab samples (see Section 3.2.2 for discussion of visible vermiculite scoring).

Bike Path (Unpaved or Partially Paved)

Bike Path (Paved, as of Sept. '10)

Storm Water Containment and Waste Water Lagoon Area

Waste Bark Piles Debris

Approved Waste Bark Disposal Area

MotoX Track

Worker ABS Areas

OU5 Boundary

OU4 (limits are approximately in vicinity of Libby Creek)

Abatement Response Action Areas¹

Buildings - Occupied

Buildings - Vacant (Existing Buildings as of May 2013)

Buildings - Open Air (less than four walls)

Surface Water

Libby Groundwater Superfund Site

Railroad Spur

Former Popping Plant

Lumber Yard

Former Champion Int. Tree Nursery

Log Storage Area

Southwest Area

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Visible Vermiculite

in Surface Soils

Remedial Investigation

Operable Unit 5 - Libby Asbestos Site

Libby, Montana

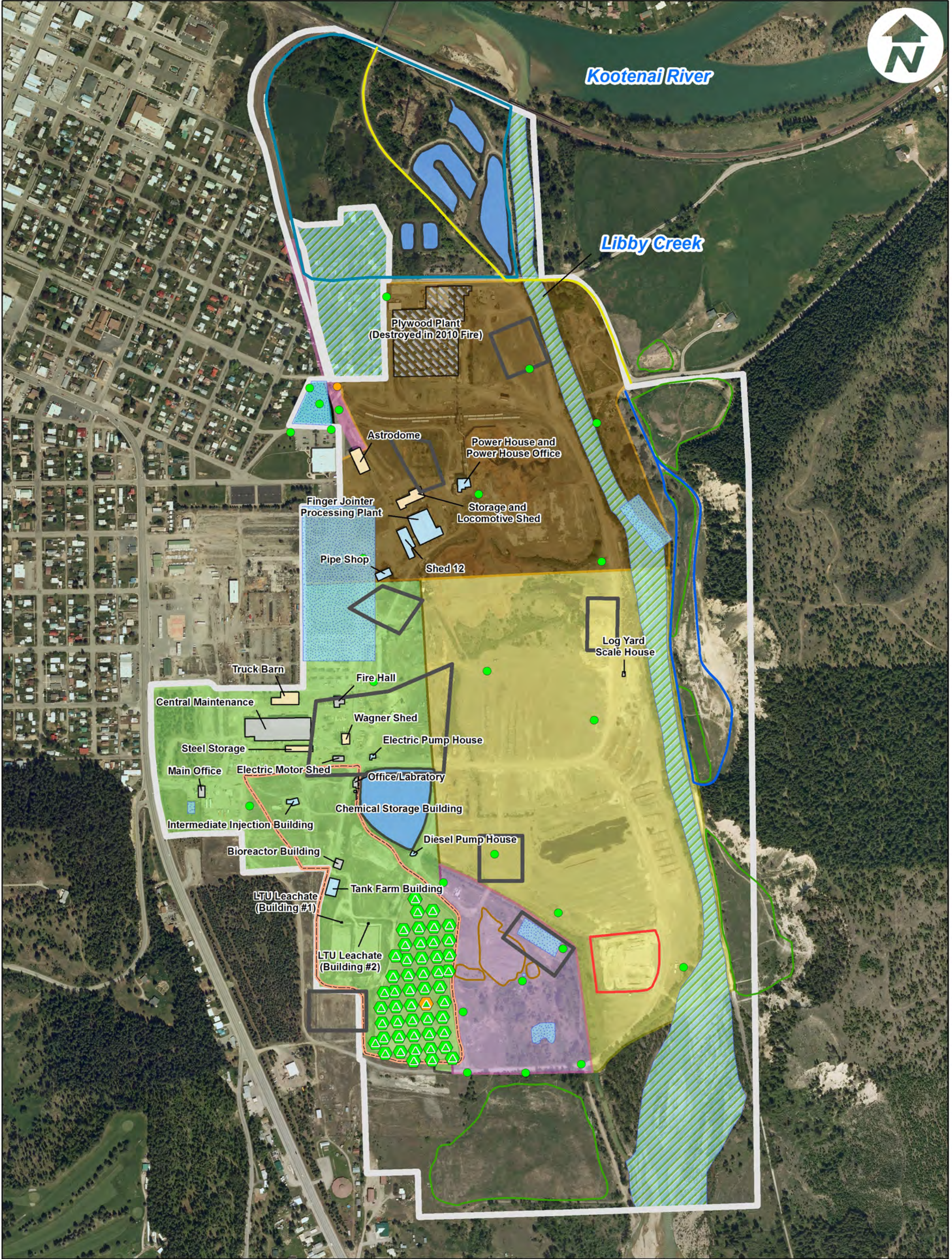
DATE: MAY, 2013

Figure 5-5

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Miles

¹Results shown on Figure reflect testing done before abatement actions. See Figure 1-4 & Table 1-1 for details on response actions taken at OU5.



Sub-Surface Soil Results

LA in Sub-surface (Grab)

- < 1%
- Trace
- Non-Detect

LA in Sub-surface (Composite)

- >= 1%
- < 1%
- Trace
- Non-Detect

Visible Vermiculite Level (Grab)

- High
- Moderate
- Low
- None

- Bike Path (Unpaved or Partially Paved)
- Bike Path (Paved, as of Sept. '10)
- Worker ABS Areas
- Storm Water Containment and Waste Water Lagoon Area
- Waste Bark Piles Debris
- Approved Waste Bark Disposal Area
- MotoX Track
- Libby Groundwater Superfund Site
- OU5 Boundary
- OU4 (limits are approximately in vicinity of Libby Creek)
- Abatement Reponse Action Areas²

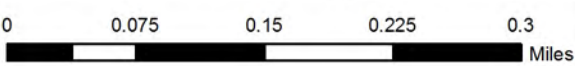
- Buildings - Occupied
- Buildings - Vacant (Existing Buildings as of May 2013)
- Buildings - Open Air (less than four walls)
- Surface Water
- Railroad Spur
- Former Popping Plant
- Lumber Yard
- Former Champion Int. Tree Nursery
- Log Storage Area
- Southwest Area

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LA and Visible Vermiculite in Sub-Surface Soil

Remedial Investigation
Operable Unit 5 - Libby Asbestos Site
Libby, Montana

DATE: MAY, 2013 Figure 5-6



² Results shown on Figure reflect testing done before abatement actions. See Figure 1-4 & Table 1-1 for details on response actions taken at OU5.

¹ See Section 3.2.2.

Appendices

Appendix A

Response Action Reports

Appendix A1
OU5 Redevelopment Area
Investigation Summary



Memorandum

To: Amishi Castelli, Volpe Center Task Order Manager

From: Thomas Cook, CHMM, CDM Field Investigation Manager

Date: May 12, 2009

Subject: Investigation Summary – OU5 Re-development Area

Background

CDM Federal Programs Corporation (CDM) was tasked with performing investigation activities within a designated area on the former Stimson Lumber Company site, OU5, to support future re-development activities. The investigation consisted of collecting soil samples for Libby amphibole (LA) asbestos analysis, performing inspections for vermiculite, and delineating areas with LA contamination and/or vermiculite for subsequent removal activities.

Investigation Summary

All work was completed in accordance with the technical memorandum dated April 17, 2009 from Thomas Cook to Amishi Castelli, Subject: Soil Sampling and Visual Inspection – OU5 Re-development Area (CDM 2009). The investigation activities were performed April 20 through April 22, 2009. Prior to field activities, a field planning meeting was held with key members of the field sampling team to review the sampling plan and procedures. There were no deviations in sampling or inspections from the technical memorandum or associated documents.

Eight sampling zones were established, sampled, and inspected in accordance with the technical memorandum (Figure 1). Only soil/gravel areas within the identified zones were sampled and inspected. Areas covered with concrete or pavement were not included as part of this inspection. Figure 2 illustrates the detail of each sampling zone and location of vermiculite observed. Copies of logbook entries, field sample data sheets, and visual vermiculite estimation forms are included in Attachment A.

A total of nine soil samples (eight field samples and one field duplicate) were collected. In addition, vermiculite inspections were performed in each sampling zone. All soil samples were analyzed for LA by the polarized light microscopy-visual estimation method (SRC 2008). Analytical results for all samples were non-detect for LA (Attachment B). Low amounts of vermiculite were observed in zones six and seven. In zone six, vermiculite was observed

concentrated within a specific area between the north road and concrete slab (Figure 2). Within zone seven, vermiculite was observed widespread throughout the entire zone. The following table summarizes the analytical and vermiculite inspection results for each sampling zone:

Zone	Sample Index ID	Analytical Result (Percent Libby Amphibole)	Number of Vermiculite Inspection Points by Zone			
			None	Low	Medium	High
1	SL-01760	Non-detect	30	0	0	0
2	SL-01761	Non-detect	30	0	0	0
2	SL-01768 ¹	Non-detect	30	0	0	0
3	SL-01762	Non-detect	30	0	0	0
4	SL-01763	Non-detect	30	0	0	0
5	SL-01764	Non-detect	30	0	0	0
6	SL-01765	Non-detect	30	6 ²	0	0
7	SL-01766	Non-detect	30	10 ³	0	0
8	SL-01767	Non-detect	30	0	0	0

¹sample SL-01768 is a field duplicate of SL-01761

²concentrated in specific area

³widespread throughout sample zone

Removal Activities

Areas requiring removal activities were identified based on results of this inspection and information gathered during previous investigations. In general, areas were identified for removal if vermiculite was observed and/or analytical results had detectable levels of LA. Figure 3 illustrates the areas requiring removal activities.

Prior to removal activities, a government representative will meet with the property owner to review the removal plan. During removal activities, only government-authorized personnel are allowed to access the areas being remediated.

All work at the property will be conducted in accordance with the Comprehensive Site Health and Safety Plan (CDM 2006) and the Response Action Work Plan, Revision 2 (CDM 2008a).

The following table summarizes the areas identified for removal and planned restoration activities.

Area	Rationale	Approximate Area (ft ²)	Excavation	Approximate Volume (yd ³)	Restoration
A	Vermiculite ¹	10,845	6 inches below surrounding grade	822	¾-inch minus crushed rock to grade
B	Vermiculite ²	25,300	12 inches below grade	937	¾-inch minus crushed rock to grade
C	Vermiculite ²	5,315	12 inches below grade	197	¾-inch minus crushed rock to grade

¹observed during vermiculite inspection June 2008

²observed during vermiculite inspection April 2009

ft² – square feet

yd³ – cubic yards

The total volume of material to remove is approximately 1,956 cubic yards. Area A, including mounded areas, will be excavated to 6 inches below surrounding grade. Areas B and C will be excavated to 12 inches below grade. Confirmation soil samples will be collected in accordance with the Response Action Sampling and Analysis Plan, Revision 1 (CDM 2008b). All areas will be restored with ¾-inch minus crushed rock (structural fill) to grade.

References

CDM. 2006. Comprehensive Site Health and Safety Plan, Revision 5. Libby Asbestos Project, Libby, Montana. December.

_____. 2008a. Response Action Work Plan, Revision 2, Libby Asbestos Project, Libby, Montana. February.

_____. 2008b. Response Action Sampling and Analysis Plan, Revision 1, Libby Asbestos Project, Libby, Montana. April.

_____. 2009. Technical Memorandum from Thomas Cook to Amishi Castelli, Subject: Soil Sampling and Visual Inspection – OU5 Re-development Area. April.

SRC. 2008. Analysis of Asbestos Fibers in Soil by Polarized Light Microscopy, SOP No. SRC-LIBBY-03, Revision 2. October.

Amishi Castelli
May 12, 2009
Page 4

cc: Julie Borgesi - Volpe Center, Cambridge
Courtney Zamora - Volpe Center, Libby
Dee Warren - CDM, Denver
Terry Crowell - CDM, Libby
Libby Project File - Denver

Figure 1

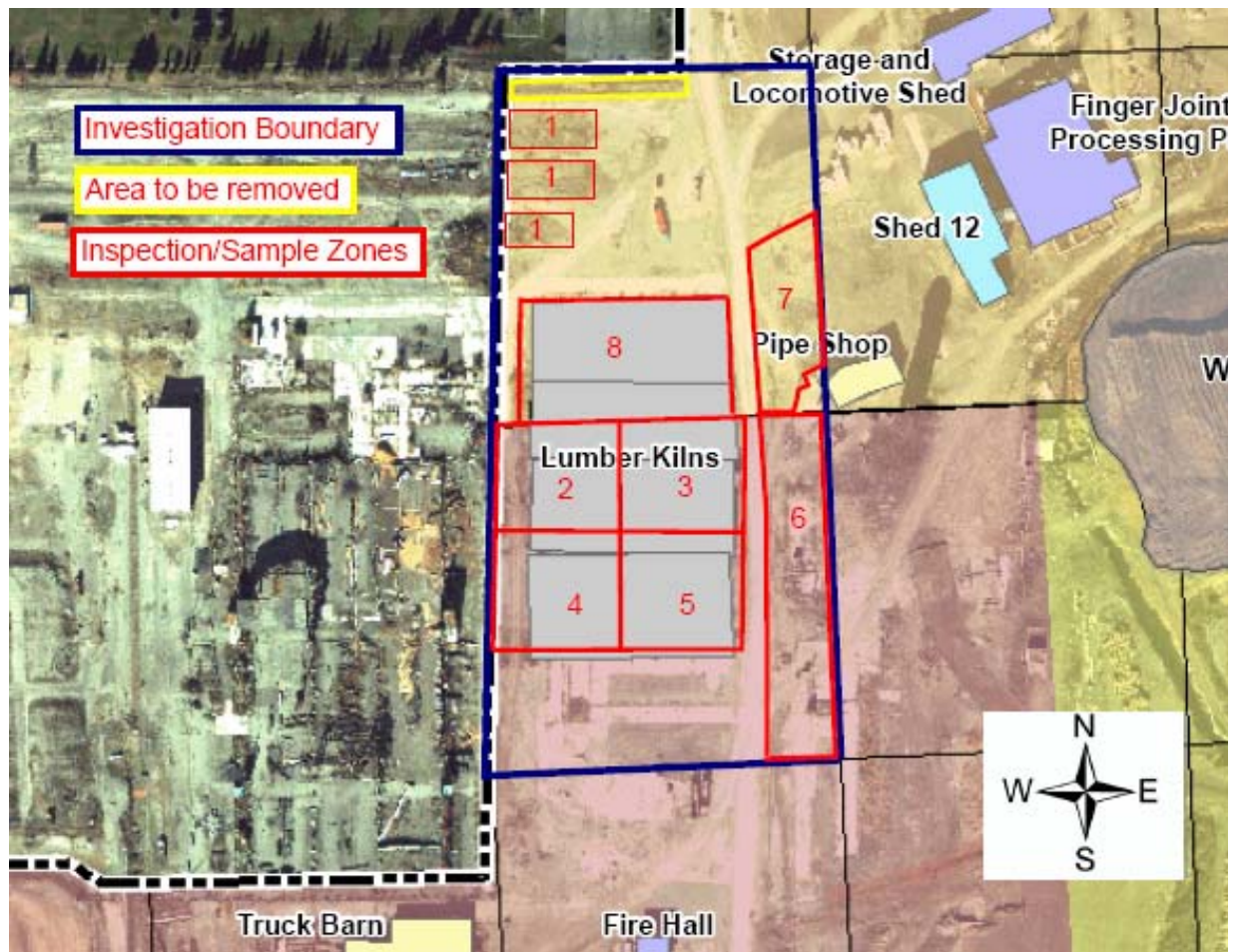
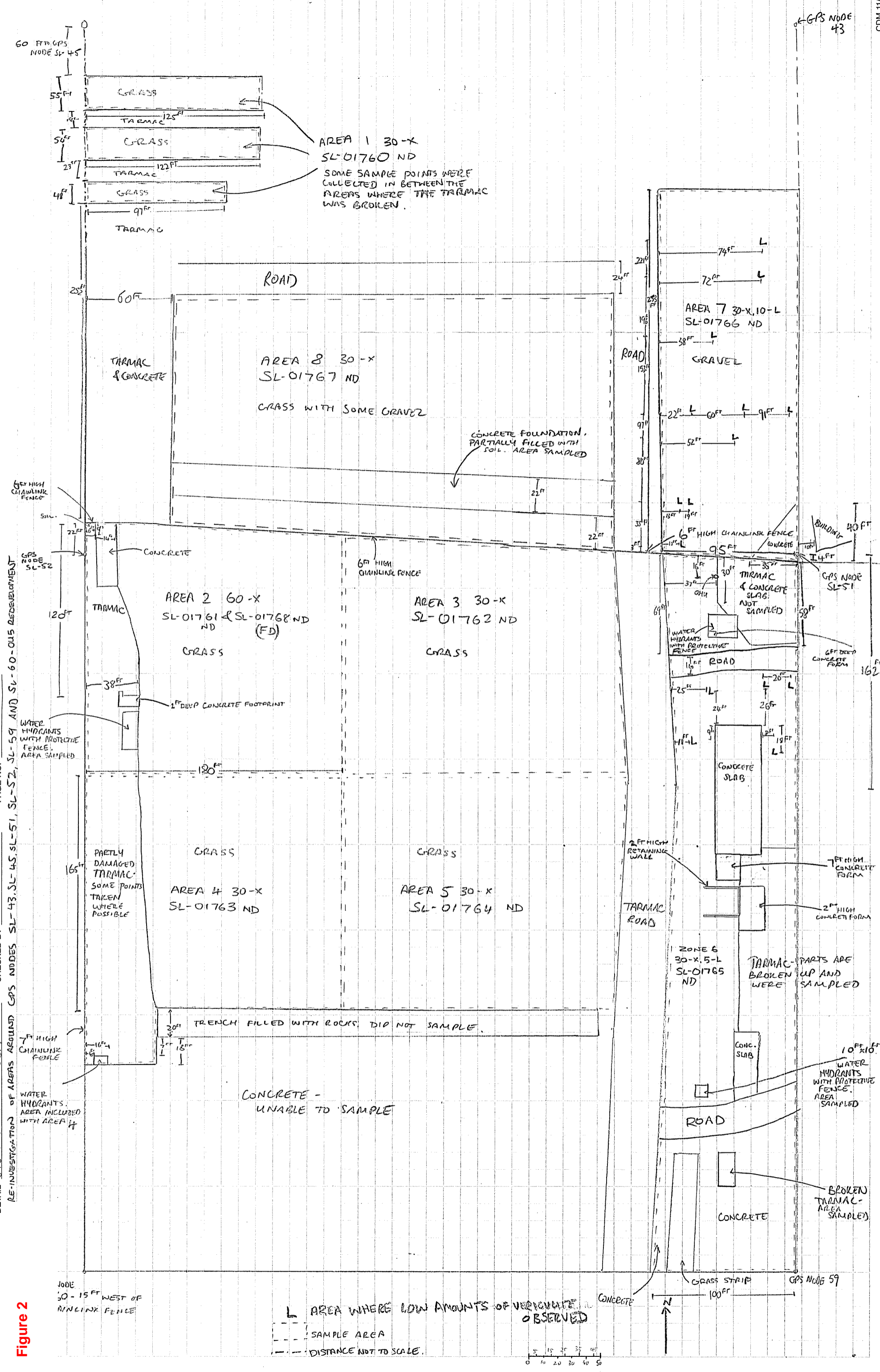


Figure 2



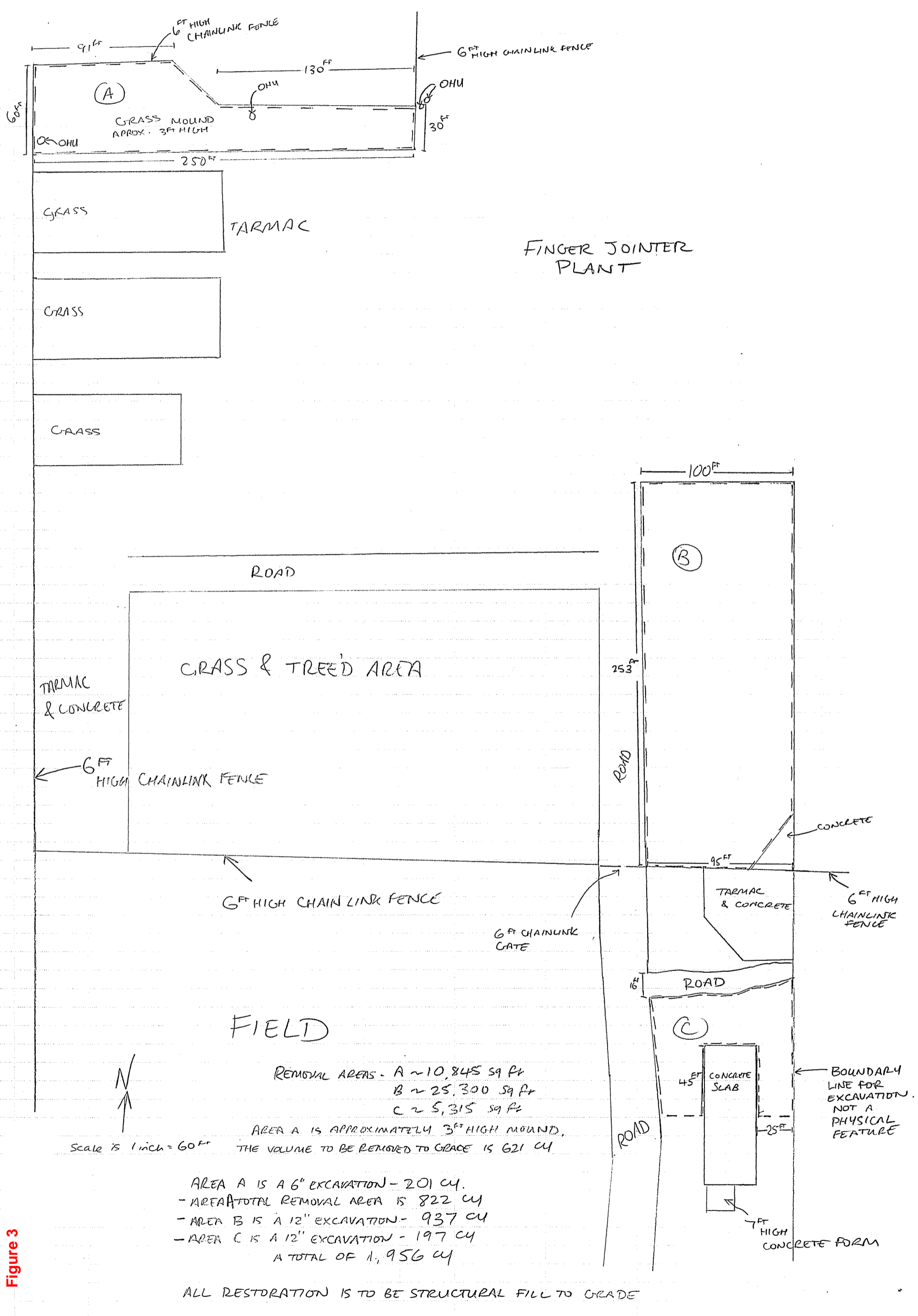


Figure 3

Attachment A

Field logbooks, field sample data sheets, and visual vermiculite estimation form

Volpe/Libby Asbestos Project Logbook: 101093

Owner: STIMSON LUMBER Date: 4-20-2009

Address: 875 Highway 2S

Author: A.M. Crites Weather: Sunny 60°

Personnel: A.M. Crites, S. Wilson

Activities: SAMPLING & VISUAL INSPECTION

PPE: Level D Modified

All activities completed in accordance w/governing doc.
PDIWP, SOP CDM-Libby-06, Rev.1, and SOP CDM-Libby-05, Rev. 2.

Trimble 6: ProXRS Asset Surveyor 5.27

Datalogger: 0220169420

Antenna: 0220173334

Receiver: 0220270969

1300 ON site to ~~collect~~ map out sample collection areas for site development plan, per Technical Memorandum - OUS Re-development Area 04/17/09; Addendum - Initial Soils Data Gap Sample Collection Visual Vermiculite Inspection OUS, June 2008. Sampling will consist of 8 field soil samples plus one field duplicate. Team investigates sample area and designates sample ~~areas~~ zones. Some zones were decreased due

AMC 4-20-09

20 Volpe/Libby Asbestos project Logbook 101093
875 Highway 2 ^S Stimson Lumber 4-20-09
to large amounts of concrete and asphalt.
1420 Nick Raines, Field Team Leader,
COM, on site to approve zone size
changes.

1425 N. Raines off site
1515 Team off site to update maps.
1600 Team on site to stake out
sample zones, complete AHA form.
1430 Team off site ~~AMC 4-20-09~~
April 21, 2009

0935 A.M. Crites on site to begin
sampling and visual inspection
Weather: sunny 45°; PPE: Level D,
modified. A.M. Crites completes AHA form.

1015 S. Wilson on site to begin
sampling and visual inspection
12:00 Team off site for lunch
13:00 Team on site to resume sampling
Visible vermiculite observed
in ~~zones~~ ^{zones} 6 and 7.
~~AMC 4-21-09~~

No visible vermiculite in zones
1, 2-5, or 8.

Field duplicate collected in
zone 2.

AMC
4.21.09

Volpe/Libby Asbestos Project logbook 101093 21
875 Highway 2 ^S Stimson Lumber 4-21-09

GPS points collected for all samples
All equipment decontaminated
between samples and IDW
disposed of as ACM according
to SOP.

The following samples were
collected:

Zone 1: SL-01760, SP-136649, no
visible; FSDS S-005457

Zone 2: SL-01761, SP-136650, no
visible; FSDS S-005457

Zone 3: SL-01762, SP-136651, no
visible; FSDS S-005457

Zone 4: SL-01763, SP-136652, no
visible; FSDS S-005458

Zone 5: SL-01764, SP-136653, no
visible in sample area FSDS S-005458

Zone 6: SL-01765, SP-136654, no
visible in sample area FSDS-005458

4 L in area south of E-W road,
E of main road in north half of
Zone 6

Zone 7: SL-01766, SP-136655, no visible
in sample area FSDS S-005459.

AMC 4.21.09

22 Kolpe/Libby Asbestos Project Logbook 101093
875 Highway 2 ^S ~~W~~ Stimson Lumber 4-21-09
10 L Visible in Zone 7. Sample 4-22-09

collected in areas with no visible.

Zone 8: SL-01767, SP-136656, no visible.

Field Duplicate: SL-01768, SP-136650

no visible. Duplicate of SL-01761.

Photos taken of all areas

1520 T. Cook, Field Investigation

Manager, on site to observe sampling
and consult with team. Approved
sampling in zones 6 and 7 where
visible vermiculite was present,
but not in sample points collected.

1555 T. Cook off site

1630 Team concludes sampling. All
equipment decontaminated and IDW
disposed of as ACM per SOP.

1655 Samples relinquished to Christy
Billbut and Tracy Dodge, Sample
Coordinators under CAC. ^{Amc} 4-21-09

April 22, 2009

0900 S. Wilson returns to site to
collect measurements for UEF map.

1025 S. Wilson back in CDM office

relinquish logbook to S. Wilson

Ann Marie Cites
4-22-09

LIBBY FIELD SAMPLE DATA SHEET (FSDS) FOR SOIL

Field Logbook No: 101093 Page No: 19-21 Sampling Date: 4-21-2009Address: 875 HIGHWAY 2 S Owner/Tenant: STIMSON LUMBERBusiness Name: STIMSON LUMBERLand Use: Residential School Commercial Mining Roadway Other ()Sampling Team: CDM Other _____ Names: S. Wilson, A. M. Crites

Data Item	Sample 1 ①	Sample 2 ②	Sample 3 ③
Index ID	SL- 01760 <u>AMC</u>	SL- 01761 <u>AMC</u>	SL- 01762 <u>AMC</u>
Location ID	SP- 136649 <u>4/20.09</u>	SP- 136650 <u>4/20.09</u>	SP- 136651 <u>4/20.09</u>
Sample Group	PROPERTY _____ →		
Location Description (circle)	Back yard Front yard Side yard <u>AREA 1</u> Driveway <u>Other</u>	Back yard Front yard Side yard <u>AREA 2</u> Driveway <u>Other</u>	Back yard Front yard Side yard <u>AREA 3</u> Driveway <u>Other</u>
Category (circle)	<u>FS</u> FD of _____ EB LB	<u>FS</u> FD of _____ EB LB	<u>FS</u> FD of _____ EB LB
Matrix Type (Surface soil unless other wise noted)	<u>Surface Soil</u> Other _____	<u>Surface Soil</u> Other _____	<u>Surface Soil</u> Other _____
Type (circle)	Grab <u>Comp. # subsamples 30</u>	Grab <u>Comp. # subsamples 30</u>	Grab <u>Comp. # subsamples 30</u>
GPS Status (circle)	<u>Collected</u> Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	<u>Collected</u> Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	<u>Collected</u> Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample
GPS File (fill in or circle)	Filename: <u>T6A04219</u> NA	Filename: <u>T6A04219</u> NA	Filename: <u>T6A04219</u> NA
Sample Time	<u>1030</u>	<u>1055</u>	<u>1140</u>
Top Depth (inches below ground surface)	<u>0</u>	<u>0</u>	<u>0</u>
Bottom Depth (inches below ground surface)	<u>6</u>	<u>6</u>	<u>6</u>
Field Comments <i>Note if vermiculite is visible in sampled area</i>	BD- <u>AD-000686</u> <u>NO VISIBLE</u> →	BD- <u>AD-000686</u>	BD- <u>AD-000686</u>
Entered (LFO) _____	Volpe: Entered _____ Validated _____	Volpe: Entered _____ Validated _____	Volpe: Entered _____ Validated _____

For Field Team Completion (Provide Initials)

Completed by: AMCQC by: SW

LIBBY FIELD SAMPLE DATA SHEET (FSDS) FOR SOIL

Field Logbook No: 101093 Page No: 19-21 Sampling Date: 4.21.2009
 Address: 875 Highway 2S Owner/Tenant: STIMSON LUMBER
 Business Name: STIMSON LUMBER
 Land Use: Residential School Commercial Mining Roadway Other ()
 Sampling Team: CDM Other _____ Names: S. Wulson, A. M. Crites

Data Item	Sample 1 ④	Sample 2 ⑤	Sample 3 ⑥
Index ID	SL- 01763 <i>AMC</i>	SL- 01764 <i>AMC</i>	SL- 01765 <i>AMC</i>
Location ID	SP- 136652 <i>4.20.09</i>	SP- 136653 <i>4.20.09</i>	SP- 136654 <i>4.20.09</i>
Sample Group	PROPERTY →		
Location Description (circle)	Back yard Front yard Side yard <i>AREA 4</i> Driveway Other _____	Back yard Front yard Side yard <i>AREA 5</i> Driveway Other _____	Back yard Front yard Side yard <i>AREA 6</i> Driveway Other _____
Category (circle)	<u>FS</u> FD of _____ EB LB	<u>FS</u> FD of _____ EB LB	<u>FS</u> FD of _____ EB LB
Matrix Type (Surface soil unless other wise noted)	<u>Surface Soil</u> Other _____	<u>Surface Soil</u> Other _____	<u>Surface Soil</u> Other _____
Type (circle)	Grab <u>Comp. #</u> subsamples <u>30</u>	Grab <u>Comp. #</u> subsamples <u>30</u>	Grab <u>Comp. #</u> subsamples <u>30</u>
GPS Status (circle)	<u>Collected</u> Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	<u>Collected</u> Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	<u>Collected</u> Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample
GPS File (fill in or circle)	Filename: <u>T6A04219</u> NA	Filename: <u>T6A04219</u> NA	Filename: <u>T6A04219</u> NA
Sample Time	<u>1355</u>	<u>1330</u>	<i>AMC</i> 1500 <u>1548</u> <i>4.21.09</i>
Top Depth (inches below ground surface)	<u>0</u>	<u>0</u>	<u>0</u>
Bottom Depth (inches below ground surface)	<u>6</u>	<u>6</u>	<u>6</u>
Field Comments <i>Note if vermiculite is visible in sampled area</i>	BD- <u>AD-000686</u> NO VISIBLE →		
Entered (LFO) _____	Volpe: Entered _____ Validated _____	Volpe: Entered _____ Validated _____	Volpe: Entered _____ Validated _____

For Field Team Completion (Provide Initials)

Completed by: *AMC*QC by: *SV*

LIBBY FIELD SAMPLE DATA SHEET (FSDS) FOR SOIL

Field Logbook No: 101093 Page No: 19-21 Sampling Date: 4-20-09 ^{AMC} 4-21-09Address: 875 Highway 20 Owner/Tenant: STIMSON LUMBER ⁴⁻²¹⁻⁰⁹Business Name: STIMSON LUMBERLand Use: Residential School Commercial Mining Roadway Other ()Sampling Team: CDM Other Names: S. Wilson, A.M. Crites

Data Item	Sample 1 ^①	Sample 2 ^②	Sample 3 ^③
Index ID	* SL- 01766 ^{AMC}	SL- 01767 ^{AMC}	SL- 01768 ^{AMC}
Location ID	SP- 136655 ⁴⁻²⁰⁻⁰⁹	SP- 136656 ⁴⁻²⁰⁻⁰⁹	SP- 136650 ⁴⁻²⁰⁻⁰⁹
Sample Group	PROPERTY →		
Location Description (circle)	Back yard Front yard Side yard Driveway <u>Other</u> AREA 7	Back yard Front yard Side yard Driveway <u>Other</u> AREA 8	Back yard Front yard Side yard Driveway <u>Other</u> AREA 2
Category (circle)	<u>FS</u> FD of _____ EB LB	<u>FS</u> FD of _____ EB LB	<u>FS</u> ^{SL- 01761} <u>FD of SE 01764 SW</u> ⁴⁻²¹⁻⁰⁹ EB LB
Matrix Type (Surface soil unless other wise noted)	<u>Surface Soil</u> Other _____	<u>Surface Soil</u> Other _____	<u>Surface Soil</u> Other _____
Type (circle)	<u>Grab</u> <u>Comp. # subsamples 30</u>	<u>Grab</u> <u>Comp. # subsamples 30</u>	<u>Grab</u> <u>Comp. # subsamples 30</u>
GPS Status (circle)	<u>Collected</u> Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	<u>Collected</u> Previously Collected Not Collected-no signal (3 attempts) Not Collected-not required for sample	<u>Collected</u> <u>Previously Collected</u> Not Collected-no signal (3 attempts) Not Collected-not required for sample
GPS File (fill in or circle)	Filename: <u>T6A04219</u> NA	Filename: <u>T6A04219</u> NA	Filename: <u>T6A04219</u> NA
Sample Time	1615	1125	1430
Top Depth (inches below ground surface)	0	0	0
Bottom Depth (inches below ground surface)	6	6	6
Field Comments Note if vermiculite is visible in sampled area	BD- <u>AD-000686</u> NO VISIBLE * sample is valid TE 5/11/09	BD- <u>AD-000686</u> NO VISIBLE →	BD- <u>AD-000686</u>
Entered (LFO) <u>ff</u>	Volpe: Entered _____ Validated _____	Volpe: Entered _____ Validated _____	Volpe: Entered _____ Validated _____

For Field Team Completion (Provide Initials)

Completed by: AMCQC by: SW

LIBBY SUPERFUND SITE
Visual Vermiculite Estimation Form (VVEF)

Field Logbook No.: 101093

Page No.: 19Site Visit Date: 4/21/2009

BD Number: AD-000686

Address: 875 Hwy 2 S

Structure Description:	<u>Property</u>
1. A single node.	Leaf Node
2. Two nodes connected by an edge.	Edge Node
3. Three nodes connected by two edges.	Path Node
4. Four nodes connected by three edges.	Star Node
5. Five nodes connected by four edges.	Ring Node
6. Six nodes connected by five edges.	Tree Node
7. Seven nodes connected by six edges.	Graph Node
8. Eight nodes connected by seven edges.	Hypergraph Node
9. Nine nodes connected by eight edges.	Complex Graph Node
10. Ten nodes connected by nine edges.	Complete Graph Node

Occupant: Stimson

Phone No.: _____

Owner (If different than occupant): same

Phone No.: _____

Investigation Team: S.Wilson, A.M Crites

Investigation Name: OU5 Redevelopment

Field Form Check Completed by (100% of Forms): _____

Visual Verification by Field Team Leader (10% of forms): _____

		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8
Type (SUA/CUA/LUA/ISA)		LUA	LUA	LUA	LUA	LUA	LUA	LUA	LUA
Description		PROPERTY	PROPERTY	PROPERTY	PROPERTY	PROPERTY	PROPERTY	PROPERTY	PROPERTY
Area Size (square feet)		18119	30600	28500	29700	31350	28900 (not including concrete)	24035	49600
General Comment (Cover, etc.)		GRASS	GRASS	GRASS	GRASS	GRASS	GRASS	STRUCTURAL FILL	GRASS
Pls (X=None, L=Low, M=Intermediate, H=High)	X	30	60	30	30	30	30	30	30
	L						5	10	
	M								
	H								
Total		30	60	30	30	30	35	40	30

Areas previously identified for removal not inspected for visible vermiculite?

Yes

Location(s): Area along north boundary of GPS node SL-45 and SL-43

Attachment B

Analytical Results

FILE NAME: RESI_171988_PLM_VE.xls

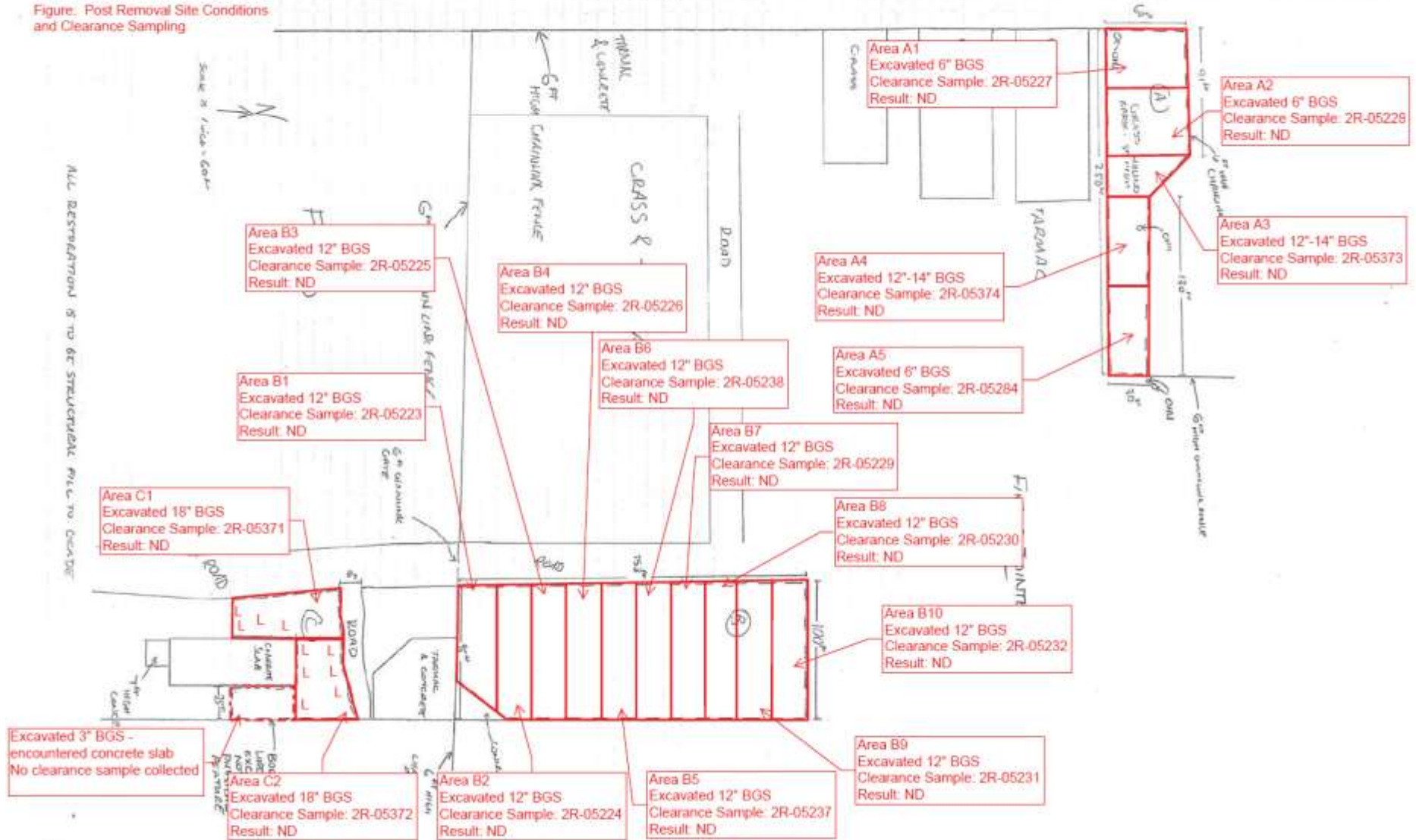
Version : 7c

PLM VISUAL ESTIMATION DATA RECORDING SHEET

Laboratory Name	RESI		Data Entry by:	K. Carliaccini
Job Number	171988		Data Entry Date:	4/29/2009
Date Received	4/28/2009			
SOP Name/Revision	SRC-LIBBY-03 (Rev 2)		QC Check by:	G. Vettraino
Spreadsheet version	7c		QC Check Date:	4/29/2009

[illegible]

ALL INFORMATION IS TO BE STRUCTURED FILE TO CURE



Appendix A2

Response Actions at Central Maintenance Building

Addendum to the Response Action Work Plan Former Stimson Central Maintenance Building Removal Plan 875 Highway 2 South

1.0 Introduction

This removal work plan is an addendum to the Response Action Work Plan (RAWP) (CDM 2003) and details specific information regarding removal activities that will take place at the Former Stimson Lumber Central Maintenance building, 875 Highway 2 South.

This plan includes building characterization data for the identification of vermiculite containing insulation (VCI), vermiculite containing building materials (VCBM), vermiculite containing soil (VCS), and evidence of Libby Amphibole (LA) asbestos in dust. Specific work to be performed on this property is also detailed on the following Contract Drawings:

- Former Stimson Central Maintenance Building Overall Site Layout - Figure 1
- Former Stimson Central Maintenance Building Interior Removal Plan - Figure 2
- Former Stimson Central Maintenance Building Exterior Removal Plan - Figure 3
- Former Mobile Shop Wall Details - Figure 4

All work on this property will be performed in consultation with the U.S. Environmental Protection Agency (EPA) On-Scene Coordinator (OSC) and in accordance with the RAWP and all other Contract Documents. All project quality assurance and quality control requirements for measurement reports will be addressed in a future data summary report.

2.0 Property Background

The following information was obtained from sampling activities and inspections performed by CDM at this property.

INTERIOR:

Overall Building Layout

- The Central Maintenance building is a rectangular, flat-roofed building, approximately 420 feet long and 142 feet wide.
- The entire building is constructed of timber main supports and wood framing. The ceiling and walls are finished with tongue and groove boards. The floor of the building is concrete slab on grade, containing several concrete vaults and pits. The roof has a 4-inch layer of aerated concrete on the tongue and groove ceiling covered by felt paper and tar.

- Walls throughout the building are constructed with 2-inch by 6-inch framing on 16-inch centers, and finished with 1-inch by 6-inch tongue and groove boards.
- The walls have equipment penetrating the wall cavities, and utilities running outside of the wall cavities.
- The building contains areas with varying wall heights. The building is separated into four areas for identification purposes relevant to this work plan (refer to Figure 1 for area locations):
 - Former Mobile Shop - a 45-foot tall structure, approximately 260 feet long and 54 feet wide, located on the north side of the building.
 - Former Engineering and Warehouse (E&W) Areas A and B - Two 15-foot tall structures, consisting of multiple spaces. A midline wall divides the two buildings along the east-west axis. The western portion of this area is currently occupied by a manufacturer of wood boilers called Seton Manufacturing. The location is shown on Figure 1.
 - Area A refers to the space north of the midline wall
 - Area B refers to the space south of the midline wall
 - Former Lift Truck Barn Area - the western portion of the building, separated from the other two areas by walls. This area is currently occupied by the business MAL Resources.
- A total of 29 dust samples were collected from all areas within the Central Maintenance Building to determine levels of LA asbestos. Analytical results for all but one dust sample are non-detect or below the level requiring cleaning for LA as directed by EPA. One dust sample collected from the Former Mobile Shop showed elevated levels of LA, necessitating cleaning of that room. Many additional rooms require spot cleaning of visible VCI, as defined and set forth in Section 4.2.

The designated areas are described in more detail below:

Former Mobile Shop

- The interior of the Former Mobile Shop is open space.
- All four walls of the shop contain VCI. However, the west wall is open from the ground up to approximately 20 feet. The area west of this opening is a bare storage area, with a lower roof, and is not considered to be part of the wall structure of the Former Mobile Shop.
- Walls in the Former Mobile Shop are vertically separated by 8-inch by 8-inch main supports into thirty-two, 20-foot wide bays. The bays are split into horizontal sections with 6-inch by 6-inch firebreaks. The wall studs divide a section into fourteen cavities. Each of these cavities contain VCI. See Figure 4 of the Contract Drawings.

- On the north wall, five of thirteen bays have 16-foot high (solid) doors; there are three wall sections above the doors which contain VCI. The remaining eight bays have four sections of wall containing VCI.
- On the south wall, the bottom section is a 19-foot high solid wall, constructed with back-to-back layers of vertical 1-inch by 6-inch tongue and groove boards. These sections do not contain VCI. The remaining two sections along the entire wall above the solid wall sections contain VCI.
- The south side exterior wall of the Former Mobile Shop has a layer of metal siding covering the tongue and groove boards. No VCI was observed within the space between the siding and the boards.
- There are two doors on the lower section of the east wall. The bay between the two doors is covered with plywood and contains fiberglass insulation in the wall cavity. The plywood is in poor condition, and the fiberglass insulation is not well contained. VCI remnants may also be present in this area of the wall.
- The upper two sections of the east wall contain VCI. The sections, combined, are about 20 feet high, and are accessible from a catwalk. A 35-ton crane and a 15-ton crane are near this wall. Two steel (2-inch diameter) cross braces across the ceiling also exists on the east wall. The braces may obstruct access to the highest wall section of north and south bay 1. The cleanup/construction contractor shall leave the braces in place, at all extent possible. If the braces require removal in order to access all VCI, they will require replacement upon completion of remediation activities.
- The west side of the room has no wall up to a height of approximately 20 feet. There are three wall sections with VCI, one below and two above the catwalk. All areas are accessible; although, there are two steel (2-inch diameter) cross braces across the ceiling that obstruct access to the highest wall section of north and south bay 13. The cleanup/construction contractor shall leave the braces in place, to the extent possible. If the braces require removal in order to access all VCI, they will require replacement upon completion of remediation activities.
- VCI is located on interior surfaces throughout the Former Mobile Shop. VCI has leaked out of the walls and collected on the crane track and supports in the Former Mobile Shop, as well as onto shelves and other horizontal surfaces.
- Subsurface vaults are located throughout the Former Mobile Shop floor. A number of them contain VCI remnants within the vaults.
- A small cinder block building is attached to the exterior of the north wall, accessible from inside the Former Mobile Shop. No VCI was observed in this area.

Former Engineering and Warehouse Area

- The Former E&W Areas A and B are divided by a midline wall. The wall is not continuous across the entire length of the building; there are doorways and openings that divide the wall into sections.
- Portions of the midline walls are finished with plywood instead of tongue and groove boards. The walls contain VCI or remnants of VCI. The walls are separated into horizontal sections with 6-inch by 6-inch beams as firebreaks.
- Penetrations and remodeling at the midline wall has caused VCI to be released on either side of the wall.
- VCI is located on interior surfaces throughout the Former E&W Area A, including shelf units and other horizontal surfaces.
- VCI in the Former E&W Area B is limited to small quantities against the wall that have leaked from penetrations and remodeling.
- Seton Manufacturing currently occupies rooms 13-1, 16-1, 18-1, 10-3, 11-3, 12-1, and 12-5. They also use room 8-3, which is a bathroom. They have access to rooms 17-2 and 17-3 but do not use these spaces.
- According to information gathered during the pre-design inspection, the interior area currently occupied by Seton Manufacturing (formerly Rohar Industries) was cleaned by the following methods. The floors were reportedly swept, power washed, and the lower few feet of the walls were power washed. In addition, Murphy's soap was reportedly used on the walls of the offices and bathroom (rooms 8-3, 10-3, 11-3, and 12-5). During inspections conducted by EPA for this Work Plan, no VCI was observed in the Seton Manufacturing area. An interior cleaning will not be required in this area; however, spot cleaning, as defined in Section 4.2, may be required in areas adjacent to the wall where VCI has since leaked from the midline wall.
- VCI was not observed on the second floor balcony in this area.

Former Lift Truck Barn

- This area includes room 19-1.
- VCI was not observed in this area of the building.
- The Former Lift Truck Barn, room 19-1, is occupied by MAL Resources, for the purpose of washing and stacking decorative stone. One wall of room 17-2 is adjacent to the Former Lift Truck Barn. This room contains equipment that may make VCI removal from the walls difficult in this space. Access to the VCI in the shared wall between rooms 17-2 and 19-1, will be made from room 19-1. Removal methods and coordination with MAL Resources are discussed further in Sections 3.1, 3.2, and 4.0.

- One dust sample was collected from the Former Lift Truck Barn area. Analytical results for the sample were non-detect for LA asbestos.

EXTERIOR:

Roof

- Building roofing material on the Former Mobile Shop is composed of an approximate 4-inch layer of aerated concrete atop the tongue and groove ceiling of the building. On top of the concrete is a layer of tar, followed by a layer of tar paper.
- The roof of the Former Mobile Shop has significant damage; the tar paper has been removed or damaged on about 30% of the roof, confined mostly to the south and east areas of the roof. This area has been covered with a tarp (see Figure 3). Inspection of the roof under the tarp revealed that most of the aerated concrete is intact, with the exception of about one-third of the material which is severely degraded and wet. The damaged material is concentrated in the south side of the repaired area.
- The eastern quarter of the Former Mobile Shop roof is covered with corrugated metal siding. There is no indication of the condition of the aerated concrete under the siding.
- Friable concrete debris is scattered around this area of the roof and on the tar paper torn from the roof.
- Three bulk samples were collected of the aerated concrete roofing material of the Former Mobile Shop. Analytical results for all three samples reveal less than 1 percent LA asbestos.
- The roof of the Former E&W Area A is also made of the same VCBM, however subsequent sampling indicates that these areas are non-detect for Libby Amphibole.
- Pallets along the wall of the Former Mobile Shop and adjacent to the Former E&W Area A roof have been contaminated with VCBM debris.
- The roof of the Former E&W Area B and the raised E&W area roof do not contain aerated concrete VCBM.
- The entire roof of the Former E&W Area (lower roof) is undamaged and in good condition.
- VCI and VCBM debris is present on all roof areas, with the exception of the Former Lift Truck Barn roof.
- All areas of the roof can be accessed by ladders. Locations are shown on Figure 3.

Vaults

- There are two subsurface features along the exterior east side of the building: a vault under a surface-level hatch located on the south east corner, and a vault under a wooden shack on the far eastern corner of the north side.

- The shack is constructed of a single wall of 1-inch by 6-inch tongue and groove boards, and is in very poor condition. The shack is a 5-foot by 4-foot structure with an open bottom, resting on a concrete vault approximately 8 feet deep. Piping in the vault is covered in part with damaged suspect asbestos containing material (ACM) pipe insulation. VCI is scattered throughout the vault, which has leaked from the Former Mobile Shop walls.
 - The vault located at the south end of the east side of the building is constructed with a soil floor and creosote-treated railroad tie walls. Vermiculite was observed in the soil floor of this vault.
 - One soil sample was collected from the floor of the southeast vault. Analytical results for this sample were non-detect for LA asbestos.

Perimeter Soil

- VCBM debris is scattered on the surface soils along the north and east sides of the building. The source is the damaged roof of the Former Mobile Shop. The debris is scattered on the ground along a 30-foot perimeter of the east and north sides of the building.
- VCI has also leaked from the Former Mobile Shop north wall and was observed in piles against the exterior north wall of the building.
- The soils located around the footprint of the building do not contain visible vermiculite, except in the southeast vault as previously discussed.
- Three soil samples were collected from the north and east perimeter of the building. Analytical results for the samples were non-detect for LA asbestos.

3.0 Health and Safety

- All removal activities at the Former Stimson Lumber Central Maintenance Building must be performed in accordance with the Libby Comprehensive Health and Safety Plan (CHASP), regulations set forth by the U.S. Occupational Safety and Health Administration's (OSHA) Title 29 Code of Federal Regulations (CFR) Parts 1926.
- All removal activities will be performed in Level C PPE as defined in the CHASP. Respiratory protection for removal activities will require use of Powered Air Purifying Respirators (PAPR's) equipped with P-100 HEPA cartridges. Personal breathing zone air samples will be collected characterizing task related personal exposures during all phases of the removal work.
- Perimeter air samples will be collected around the exclusion zone (EZ) boundary during the removal of the Former Mobile Shop roof. The southern boundary of the EZ will require the perimeter air sample to be collected on top of the lower roof south of the Former Mobile Shop roof. The north, east and west boundary of the EZ will be monitored at the ground level. Perimeter air monitoring will be completed as outlined in the RAWP.
- The cleanup/construction contractor shall submit a detailed, site-specific Health and Safety Plan for approval by the On-Scene Coordinator and the oversight contractor, prior to the

start of work. Included in this Health and Safety Plan shall be written procedures for the following specific items:

- Electrical Safety and Lock Out/Tag Out (LOTO) procedures that must be implemented by a certified electrician
 - Power Industrial Lift Truck Operations
 - OSHA 29 CFR 1926 Fall Protection
- The Former Mobile Shop roof is a low slope roof. A low sloped roof is defined as a roof having a slope less than or equal to 4 in 12 (vertical to horizontal).
- The cleanup/construction contractor shall comply with all confined space entry regulations and procedures if entry into any of sub-surface features, vaults or any other confined spaces on the site is required to perform the work set forth in this Work Plan.
- Containment areas will be constructed to segregate removal areas from the existing businesses that will be operating during removal activities. Containments must be designed according to OSHA's Class I containment specifications as listed in CFR 1926.1101, and must be constructed achieve the following requirements:
 - Negative air must be sufficient to change out the containment air volume at least 4 to 5 times per hour.
 - Negative air must be great enough to achieve a -0.02" H₂O pressure differential between containment and outside air.
 - Contamination must be pulled away from worker's breathing zone.
- Once the containment is constructed, a hazard analysis form will be completed by the Government representative to ensure compliance with all applicable Contract Documents. The Government Representative or oversight contractor will perform a smoke test in all areas of containment prior to start of work to ensure that the negative air system is sufficient to assure that asbestos fibers do not migrate to adjacent areas.
- The containment must be inspected by the cleanup/construction contractor's competent person at the beginning of each work shift to ensure the negative air system is operational and that the containment has not been breached or damaged in any manner. Any damage or breaches identified during the inspection must be repaired prior to start of work.
- Stationary air samples will be collected in both business work areas during removal operations to ensure that asbestos fiber migration is controlled. One air sample will be collected in the MAL Resources business area (19-1) during the VCI removal from the walls in room 17-2. Up to three stationary air samples will be collected in the Seton Manufacturing business area (13-1, 16-1, 18-1, 10-3, 11-3, 12-1, and 12-5) during VCI removal from the midline wall. All stationary air samples will be collected in accordance with the Contract Documents.

3.1 Coordination with Businesses

- Two businesses are currently located inside the Former Stimson Building, MAL Resources and Seton Manufacturing. See Figure 1 for locations.
- The businesses will remain operational during the removal activities, to the extent possible. The cleanup/construction contractor will coordinate with the Government representative, the oversight contractor, and the business owners to minimize the disturbance to the businesses during normal working hours.
- Electricity that is supplying the business owners will remain on during business hours during the remediation activities to the extent practical, so as to minimize disturbance to the business operation. If power must be shut down an alternative power source shall be provided to the affected businesses by the cleanup/construction contractor. There is no evidence of electrical wiring inside of the midline walls; however, the cleanup/construction contractor will take care when penetrating walls to ensure that no electrical conduits are encountered.
- The business owners will be briefed by the Site Health and Safety Officer (SHSO) on the removal activities, controlled areas, and health and safety requirements to be followed by all government employees and contractors. The business owners will be responsible for informing their employees of any requirements and restricted areas
- Additional air samples will be collected by CDM to ensure that asbestos fiber migration is prevented into the workers' areas, as discussed above.

MAL Resources

- MAL Resources currently occupies room 19-1, as shown on the Contract Drawings.
- The employees will be able to access their southwest single access door as well as their north large bay door during the duration of the remediation, except during VCI surficial vacuum of the soils along the perimeter of the building. This disturbance is minimal, and the cleanup/construction contractor shall coordinate with MAL Resources during the exterior activities to ensure that they will be able to transport their trucks in and out of the building, as necessary.
- The cleanup/construction contractor will also coordinate with MAL Resources when setting up containment around the western wall of room 17-2. This set-up will be done after business hours or on weekends to minimize disturbance to the employees.

Seton Manufacturing

- Seton Manufacturing currently occupies rooms 13-1, 16-1, 18-1, 10-3, 11-3, 12-1, and 12-5. They also use room 8-3 which is a bathroom. They have access to rooms 17-2 and 17-3, but do not use these spaces.
- The cleanup/construction contractor will coordinate with Seton Manufacturing when setting up containment around the southern side of the midline wall. The owner has agreed to move any equipment located next to the walls that are in the way of containment.

- The containment set-up will be done after business hours or on weekends to minimize disturbance to the employees, if necessary.
- The employees will have access to all their exterior doors during the duration of the remediation.
- Room 8-3 is the restroom used by Seton Manufacturing employees. The VCI in the midline wall associated with this room will be cleaned and the room cleared for use in coordination with Seton Manufacturing. The closure of this room will be minimized in order to allow Seton Manufacturing use of room 8-3 during their operating hours to the extent practicable. The cleanup construction contractor shall provide portable toilets and hand washing stations for use by Seton Manufacturing's employees for the period when the restroom is not available to them.

3.2 Containment

Containment systems must be constructed prior to the start of interior cleanup work. The building walls and ceiling require cleaning and will not be covered with 6-mil polyethylene sheeting. The building walls and ceiling will act as part of the negative pressure enclosure (NPE) and will not require coverage. The systems shall be set up as follows:

- The Former Mobile Shop will be delineated into multiple separate NPEs.
 - All doors and openings within each NPE in the Former Mobile Shop will be covered with 6-mil polyethylene sheeting. During the construction of the west NPE within the Former Mobile Shop the open west end will be covered with 6-mil polyethylene sheeting to prevent migration of asbestos fibers from the work area.
- Containment in Rooms 7-1, 8-1, 8-2, 8-3, 9-1, 10-1 will be constructed in the same manner as in 1-1 and 4-1, and, at a minimum, be ten feet north of the wall. In rooms 11-2 and 12-1 south of the Former Mobile Shop will be isolated to form a separate NPE the containment will be constructed, at a minimum, ten feet south of the wall. This will be coordinated with Seton Manufacturing as necessary.
 - The south side of the midline wall will be contained as the southern boundary of the NPE. A 6-mil polyethylene sheeting containment wall will be constructed approximately 10 feet south of the midline walls, which will be coordinated with Seton Manufacturing.
- The walls containing VCI in Room 17-2 will be isolated to form a NPE. Removal of VCI from this wall will be completed from the west side, in room 19-1. This containment will be constructed of 6-mil polyethylene sheeting extending approximately 10 feet west of the wall containing the VCI. The use of this area (within room 19-1) will be coordinated with MAL Resources, as to prevent disruption to their business.
- Room 1-1 will be isolated forming a NPE. Removal of remnant VCI will be conducted from the inside of room 1-1. A separate NPE will be constructed encompassing the midline wall extending into room 4-1.

- Room 8-3 is a restroom used by Seton Manufacturing employees. The room will be checked and any conduits, cracks, or penetrations into the north, east, and west walls will be sealed with a combination of poly sheeting and caulk in order to seal the room off from adjoining spaces. Once work activity on the midline wall in contact with room 8-3 is complete, that area will be cleared and the containment modified to allow access to room 8-3 by Seton Manufacturing employees.
- HEPA filter equipped air handling units will be placed in locations and quantity that creates a NPE in accordance with the requirements included in the RAWP.
- Clearance Criteria for all areas on the site (interior containments, interior spot cleanings, roofs, vaults, floors, exterior soils, etc.) shall be determined in consultation with the On-Scene Coordinator. Clearance methods and protocols shall also be determined in consultation with the On-Scene Coordinator.

4.0 Remediation Activities

Remediation activities must be carried out in a manner that ensures cleaned areas are not re-contaminated during work activities. To accomplish that goal, work will be performed in the following order:

- Exterior Roof Remediation
- Soil Excavation/Surface Vacuum
- VCI Bulk Removal/Spot Cleaning (to be performed simultaneously)
- Interior Cleaning/Interior Vault Remediation (to be performed simultaneously)
- Encapsulant Application (to be performed simultaneously)
- Exterior Vault Remediation

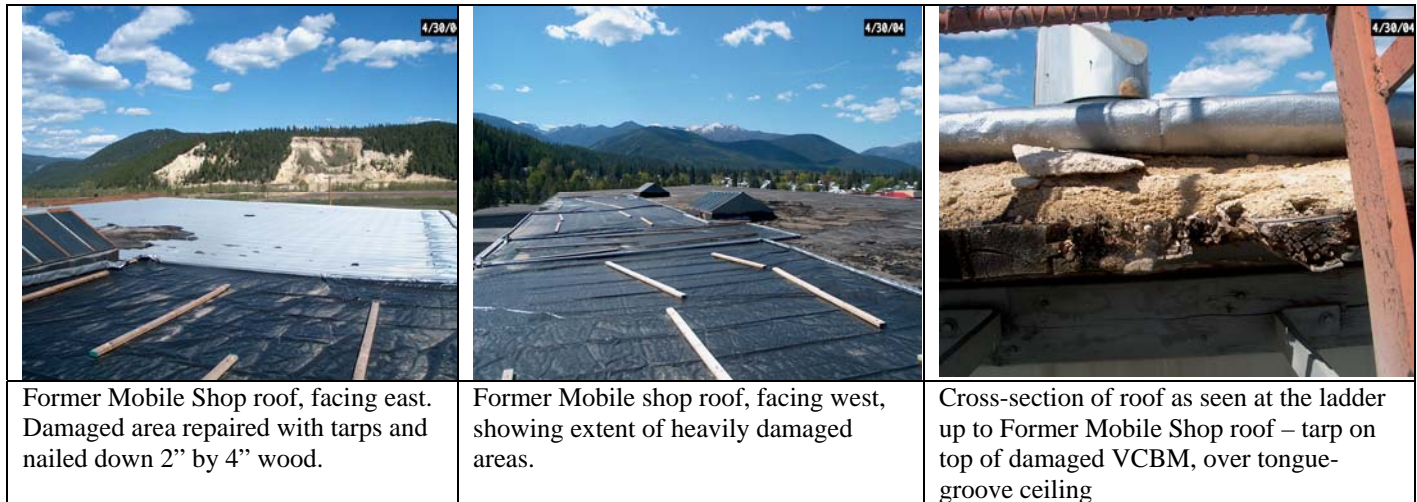
4.1 Exterior Roof Remediation

The following activities will take place on the roof of the building:

- The entire Former Mobile Shop roof will be removed and replaced with a comparable roofing material.
- The Former E&W Area A is made of the same material as the Former Mobile Shop; however, it is undamaged and does not pose a risk of an imminent release. Therefore, it will not be removed. The Former E&W Roof area B, the Former Lift Truck Barn Roof, and the Former E&W area higher roof (refer to Figure 3) do not contain VCBM aerated concrete roofing material.
- All work performed by the cleanup/construction contractor on the roofs shall be done in consultation with the EPA On-Scene Coordinator, the site Health and Safety Officer, the oversight contractor, and in accordance with this Work Plan.
- No enclosures will be constructed during the removal of the vermiculite containing aerated concrete roofing material. An exclusion zone (EZ) will be delineated at the ground level on

the north, east and west boundaries of the Former Mobile Shop. The lower roof south of the Former Mobile Shop will be the southern boundary for the EZ.

- The corrugated metal sheeting covering the eastern quarter of the Former Mobile Shop will be removed, washed and disposed of as construction debris. A layer of tar paper may be located between the aerated concrete and the corrugated metal sheeting. Any tar paper removed prior to the removal of the aerated concrete will be disposed of as ACBM.
- Either a wet cut-off saw or a circular saw equipped with HEPA equipped local exhaust ventilation will be used to score the layer of aerated concrete. The scoring should reach a depth of up to 4 inches into the layer of aerated concrete prior to removal. Great care should be taken when placing these scoring lines to ensure the bottom wooden roof deck remains undamaged. This method allows for the concurrent removal of the aerated concrete and the tar paper that is also part of the roof structure (as this tar paper contains remnants of the aerated concrete stuck on its' surface).
- Either manual scraping bars or a power assisted scraping machine will be used to lift the layer of roofing material off the wooden roof deck. During this scraping operation, wet methods will be used to limit generation of airborne dust.
- A debris chute will be constructed leading from the roof into a hazardous waste container. The shoot will be placed under negative pressure by attaching a negative air filtration unit inline on the bottom of the shoot to ensure dust is pulled into the shoot during disposal of the roofing material.



- The following roof areas will be surface vacuumed after the completion of the upper roof: entire lower (Former E&W Area) roof including the roof area west of the upper roof and the raised roof area that is approximately 10 feet higher than the lower roof area. See Figure 3 for locations. Mechanical means may be used in these areas as well. The only roof area not requiring vacuuming is the Former Lift Truck Barn roof.

- The pallets that line the edge of the Former Mobile Shop on the lower roof will be washed to remove all surficial material and returned to their original location.

		
<p>Lower roofs, facing west – these roofs are not damaged – the northern half has VCBM, southern half does not.</p>	<p>VCBM is seen as both debris and pulverized into powder, collecting at low points including around pipe penetrations (vents).</p>	<p>A row of pallets lines the edge of the lower roof adjacent to the Former Mobile Shop. These are to be washed and returned to their original location.</p>

4.2 Interior Remediation

Once the roof has been cleaned and replaced, removal of bulk VCI will take place inside the building, followed by interior cleaning and encapsulant application.

VCB Bulk Removal

- Prior to VCI removal, all large equipment items, including the two large cranes in the Former Mobile Shop, will be cleaned to remove all surficial VCI and left in place. All equipment will be covered with polysheeting during the remainder of interior remediation to protect it from being re-contaminated.
- VCI will be removed from all walls containing the material. Specifically, VCI will be removed from the following walls (see Figure 2 for locations):
 - All Former Mobile Shop walls
 - All midline walls
 - Eastern wall of room 1-1
 - Western wall of rooms 17-2 and 17-3

VCB will be removed using vacuum methods. Vacuum methods consist of using a HEPA equipped vacuum truck with a storage container in line.

- The fiberglass insulation in the east wall of the Former Mobile Shop (located in between the two bay doors) will also be removed, as it is not well contained behind the plywood wall and may contain VCI remnants. The plywood wall will be removed and disposed of as contaminated material. The plywood will be replaced with a similar comparable material.

Former Mobile Shop

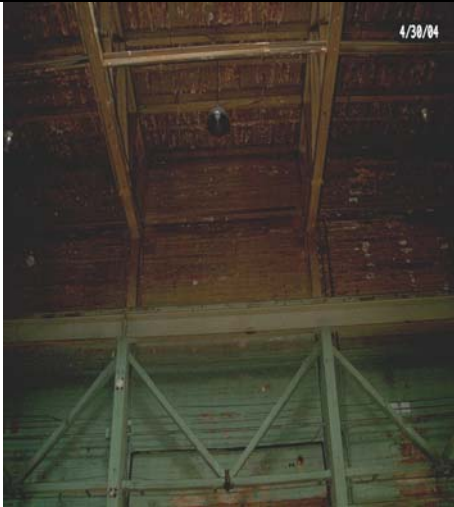
- In the Former Mobile Shop, A 6-inch diameter hole will be drilled into the tongue and groove boards in between each framing cavity to access the VCI (14 cavities per section per bay; 3 to 4 sections per bay). Adapters will be placed on the end of the vacuum hose to remove VCI from corners of the framing cavity.
- The majority of the Former Mobile Shop walls will be accessed using a man-lift with a retractable boom.
 - All bays on the north and south walls are accessible using the man-lift; this method was used successfully to access the bays during inspection.
 - Upper bays on the east and west wall can not be reached by the man-lift due to obstacles such as large cranes. These bays can be accessed from a catwalk on either side of the building.
 - The cleanup/construction contractor shall leave the 2-inch diameter steel bracing at the east and west ceiling in place, to the extent possible. Extra time may be required in order to access the wall sections that are located near the bracing. If removal of the bracing is required to access all VCI, the bracing will require replacement upon completion of remediation activities.



North side bay 13, note obstacles to work area. The stairway accesses the catwalk on the west side of the Former Mobile Shop.



North side bays 11, 10, 9 from left to right. A door and solid wall are at lower section of bay 10, Wall cavities with VCI are in all of bays 9 and 11. Trusses for crane track in front of all wall bays.



Typical upper section of bays. Note steel beam and trusses along north and south side, this feature is for the 35 ton crane stationed on the east side of shop. VCI has settled onto many of the horizontal surfaces.



West wall of the Former Mobile Shop. The catwalk is located where the color changes from green to brown. Steel bracing is at the ceiling in northeast and southeast corners, but is not visible in this photo.



Typical south bays, photo shows bays 8 and 9. The lower 19 ft. wall sections are solid in all south bays.



South side bay 12, showing some of the typical obstacles, penetrations, and utilities in the work areas.

Former E&W Areas

- VCI within the midline wall cavities, as well as rooms 1-1, 17-2 and 17-3, will be accessed using stepladders or platforms.
- The west wall of room 17-3 will be accessed and remediated through the west side of the wall.
- Holes will be drilled in these walls to access the VCI in the same manner as the walls of the Former Mobile Shop.



Room 1-1 (Fig 1). Midline wall. Walls in this room are accessible from a stepladder. These walls may contain full or remnant VCI.



Room 17-2. These walls have full or remnant VCI, and are in a small room with a fixed furnace.



Spot Cleaning

- Spot cleaning will consist of HEPA vacuuming, mopping floors, and wiping down horizontal surfaces, etc. in areas containing visible VCI but not requiring a full interior cleaning of the entire room/area.
- Spot cleaning of VCI will be completed along the south side of the midline wall and other areas within the building as necessary.

- Spot cleaning will be done in conjunction with bulk cleaning, in a manner that does not cause cross contamination between cleaned and contaminated surfaces.

Interior Cleaning

- Following bulk VCI removal, the entire Former Mobile Shop will require interior cleaning, including the lower roof Former Mobile Shop area, due to the large quantity of visible VCI located throughout the interior surfaces of the shop.
- All interior cleaning shall be performed in consultation with the On-Scene Coordinator and the oversight contractor and in accordance with this Work Plan. Strategies for the interior cleaning shall include the combined use of the HEPA vacuum, wet-wiping, and power washing of all interior surfaces within the Former Mobile Shop. The cleanup/construction contractor shall use Best Management Practices for managing and disposing of wash water and waste water generated during cleanup activities.
- Since all dust samples collected within the building were below the levels requiring cleaning as directed by EPA, no additional rooms besides the Former Mobile Shop will require interior cleaning.
- During interior cleaning of the Former Mobile Shop, all interior vaults and pits will be opened and inspected. Vaults or pits containing water and/or sludge will not be cleaned. Any dry vaults or pits will be cleaned of debris, and vacuumed to remove VCI.
- Locations of a few vaults are included in Figure 2. The cleanup/construction contractor will also inspect additional vaults and pits that are discovered during work activities and are not included on the figure.
- The cleanup/construction contractor shall comply with all confined space entry regulations and procedures if entry into any of sub-surface features, vaults or any other confined spaces on the site is required to perform the work set forth in this Work Plan.
- Clearance Criteria for all areas on the site (interior containments, interior spot cleanings, roofs, vaults, floors, exterior soils, etc.) shall be determined in consultation with the On-Scene Coordinator. Clearance methods and protocols shall also be determined in consultation with the On-Scene Coordinator.

	
<p>Some vaults have water/sludge and do not require cleaning.</p>	<p>This pit is dry and has some debris, requires cleaning by disposing of debris and vacuuming pit. This is at the middle of east wall.</p>

Encapsulant Application




- After the VCI has been removed and the work area inspected by an onsite Government representative for completeness of dust removal, encapsulant will be applied to all wall cavities that had contained VCI. Encapsulant will also be applied to exterior surfaces to ensure any remaining asbestos fibers are sealed in place. Encapsulant will not be directly applied to the floor of the Former Mobile Shop.
- Clear encapsulant material will be required in all areas requiring application of encapsulant.

4.3 Exterior Vault Cleaning and Soil Excavation

Once remediation activities are completed on the roof and inside the building, the remediation activities along the exterior perimeter of the building will commence. This will ensure cross-contamination does not occur. The following areas require remediation:



Shack and Northeast Vault

- The shack will be dismantled prior to entry to ensure the safety of workers.
- The shack materials will be properly disposed of as ACM.
- Piping inside the shack will be protected and supported, as necessary.
- All suspect ACM insulation from the pipes will be removed and properly disposed.
- The vault located in the floor of the shack will then be remediated. Confined space entry procedures may be applicable for entry into this vault. Any debris inside the vault will be discarded as ACM.
- VCI within the vault will be removed with vacuum methods.
- Encapsulant will then be applied to the walls, floor, and piping within the vault.

		
<p>The shack is located on the east end of the north side of the Former Mobile Shop (refer to Fig 2), and has VCI inside and on the ground outside. The shack will be dismantled and discarded.</p>	<p>Inside the shack – piping with remains of suspect ACM insulation. The insulation will be discarded as ACM.</p>	<p>Looking into the vault – VCI is scattered throughout this area – discard all debris within this vault – wash down and surface vacuum interior, apply encapsulant.</p>




Southeast Vault

- The vault on the southeast corner of building has vermiculite in the soil floor. However, soil samples reveal that LA asbestos is non-detect. Therefore, no remediation will be required to the soil floor of the vault.
- Any remnant VCI located on the surface of the soil floor will be vacuumed.
- Confined space entry procedures may be applicable for entry into this vault.

	
<p>Entrance to vault on the south east corner of the building. The Vault has creosote timber walls and a soil floor.</p>	<p>Floor of the vault as viewed from the entrance.</p>

Exterior Soil

- Excavation along the perimeter of the building will not be required, as analytical results of soil samples taken in the perimeter areas reveal that LA asbestos is non-detect.
- However, surficial VCBM and VCI located on the top of the soil along the north and east sides of the building will be removed by vacuum methods, from the edge of the walls and outward approximately 45 feet.
- Items located within the work area, such as the racks and shelving will be left in place and protected during surficial removal.

		
North side of Former Mobile Shop facing west, from the east end.	North side of Former Mobile Shop facing east, from the west end.	East side of Building, note the shed/shelves and pipe rack against the wall – the shed has no floor.

5.0 Restoration Activities

Restoration activities at this property will consist of performing the following work:

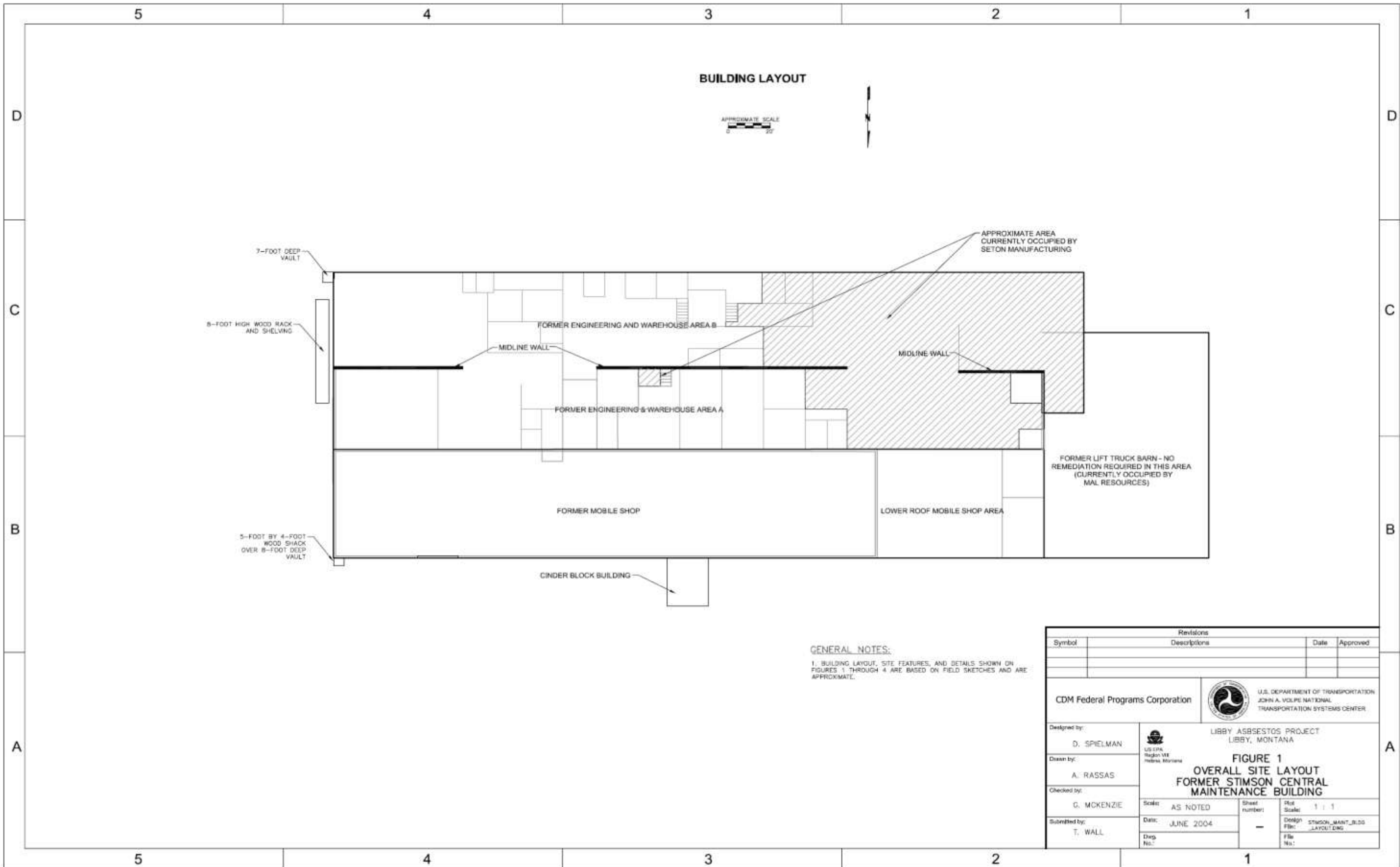
- Roof
 - Previously discussed in Section 4.1.
- Former Mobile Shop
 - Blown-in fiberglass will be installed in all exterior walls of the Former Mobile Shop, which includes the entire north and east walls, and the upper portion of the south and west walls.
 - All holes that were made in the walls to access the VCI will be repaired and sealed.

- Former E&W Areas A and B
 - Blown-in fiberglass will be installed in the eastern wall of room 1-1. The interior walls, including the midline wall and walls of rooms 17-2 and 17-3, will not be insulated.
 - All holes that were made in the walls to access the VCI will be repaired and sealed.
- Shack and northeast vault
 - The shack will not be re-built.
 - A cover will be constructed over the vault for safety purposes, constructed of plywood and a 2-inch by 4-inch frame to fix the plywood into place, and cement or steel anti-collision posts will be placed to protect the vault from vehicular traffic.

6.0 References

CDM. 2003. Response Action Work Plan (RAWP), EPA Libby Asbestos Project, Libby, Montana. November.



CHASP. Libby Comprehensive Health and Safety Plan, EPA Libby Asbestos Project, Libby, Montana. May 2003.



GENERAL NOTES:

1. BUILDING LAYOUT, SITE FEATURES, AND DETAILS SHOWN ON FIGURES 1 THROUGH 4 ARE BASED ON FIELD SKETCHES AND ARE APPROXIMATE.

Revisions			
Symbol	Descriptions	Date	Approved

CDM Federal Programs Corporation		 U.S. DEPARTMENT OF TRANSPORTATION JOHN A. VOLPE NATIONAL TRANSPORTATION SYSTEMS CENTER	
Designed by: D. SPIELMAN	 U.S. EPA Region VII Indiana, Missouri	LIBBY ASBESTOS PROJECT LIBBY, MONTANA	
Drawn by: A. RASSAS		FIGURE 1 OVERALL SITE LAYOUT FORMER STIMSON CENTRAL MAINTENANCE BUILDING	
Checked by: G. MCKENZIE		Scale: AS NOTED	
Submitted by: T. WALL	Date: JUNE 2004	Sheet number: -	Plot Scale: 1 : 1
Design File: STIMSON_MAINT_BLDG_LAYOUT.DWG	File No.:		

INTERIOR REMOVAL PLAN NOTES:

(SEE CONTRACT DOCUMENTS FOR ADDITIONAL INFORMATION)

1. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH ALL HEALTH AND SAFETY REQUIREMENTS, IN ADDITION TO THOSE SPECIFIED IN THE RESPONSE ACTION WORK PLAN ADDENDUM.
2. ALL WORK SHALL BE PERFORMED IN THE SEQUENCE SPECIFIED IN THE RESPONSE ACTION WORK PLAN ADDENDUM.
3. REMOVE ALL INSULATION FROM THE WALLS OF THE FORMER MOBILE SHOP, MIDLINE WALLS, EAST WALL OF ROOM 1-1, WEST WALL OF ROOM 17-2, AND WEST WALL OF ROOM 17-3.
4. THE CONTRACTOR SHALL INSPECT ALL VAULTS FOR VCI, AND SURFICIAL VACUUM VCI WITHIN VAULTS.
5. THE CONTRACTOR SHALL PERFORM INTERIOR CLEANING IN THE FORMER MOBILE SHOP.
6. THE CONTRACTOR SHALL PERFORM SPOT CLEANING IN THE AREAS SOUTH OF THE MIDLINE WALL, AND ALL OTHER ROOM CONTAINING VISIBLE VCI.
7. THE CONTRACTOR SHALL APPLY CLEAR ENCAPSULANT ON ALL WALLS THAT CONTAINED VCI AND ON THE FORMER MOBILE SHOP FLOOR.

INTERIOR REMOVAL PLAN

PLAN VIEW

APPROXIMATE SCALE
0 20'

SECOND LEVEL - OFFICES AND PARTS STORAGE

ACCESS DOORS FOR SETON MANUFACTURING DURING ENTIRE DURATION OF INTERIOR REMEDIATION

PLYWOOD OVER WALL STUDS, TONGUE AND GROOVE HAS BEEN REMOVED ON THIS SIDE.

VCI REMNANTS AT BACK OF WALL

FIBERGLASS AND VCI IN WEST WALL SEE FIGURE 4 FOR WALL DETAIL

VACUUM SURFICIAL VCI FROM VAULT WITH STEEL GRATE. THIS VAULT CONTAINS PIPING FOR CITY WATER (WORKING)

APPROXIMATE LOCATIONS OF THE 35-TON AND 15-TON CRANES

NO VCI IN LOWEST SECTION OF BAY 3

CINDER BLOCK BUILDING

ACCESS DOOR FOR CONTRACTOR, AS NEEDED DURING DURATION OF INTERIOR REMEDIATION OF WALL 17-2

ACCESS DOORS FOR MAL RESOURCES DURING ENTIRE DURATION OF INTERIOR REMEDIATION

CONTRACTOR SHALL COORDINATE WITH MAL RESOURCES FOR USING BAY DOOR ACCESS

VCI INSULATION QUANTITIES - MOBILE SHOP

LOCATION	BAYS	SECTION	AREA (SF)	THICKNESS (IN)	# OF BAYS	VOLUME (CY)
SOUTH WALL	2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13	1	380	0	—	—
		2	220	6	11	45
		3	300	6	11	61
	1	1	380	0	—	—
		2	110	6	1	2
		3	150	6	1	3
	7	1	380	0	—	—
		2	220	6	1	4
		3	150	6	1	3
NORTH WALL	1, 5, 7, 9, 11, 13	1	250	6	6	28
		2	240	6	6	27
		3	240	6	6	27
		4	120	6	6	13
	2, 4, 6, 8, 10, 12	1	320	0	—	—
		2	160	6	6	18
		3	240	6	6	26
		4	120	6	6	13
	3	1	250	0	—	—
		2	240	6	1	4
		3	240	6	1	4
		4	120	6	1	2
EAST WALL (VCI)		NA	1406	6	NA	27
EAST WALL (FIBERGLASS)		NA	224	6	NA	4
WEST WALL		NA	1350	6	NA	25

VCI INSULATION QUANTITIES - E&W AREAS

LOCATION	LENGTH (LF)	HEIGHT (FT)	THICKNESS (IN)	VOLUME (CY)
MIDLINE WALLS	195	15	6	54
ROOM 1-1	40	15	6	11
ROOM 17-2	10	15	6	3
ROOM 17-3	21	15	6	6

LEGEND

- BAY DOOR
- SINGLE DOOR
- VCI WALL INSULATION
- 11-1 ROOM NUMBER
- ROOM REQUIRES INTERIOR CLEANING



1 EXTERIOR - EAST SIDE OF BUILDING



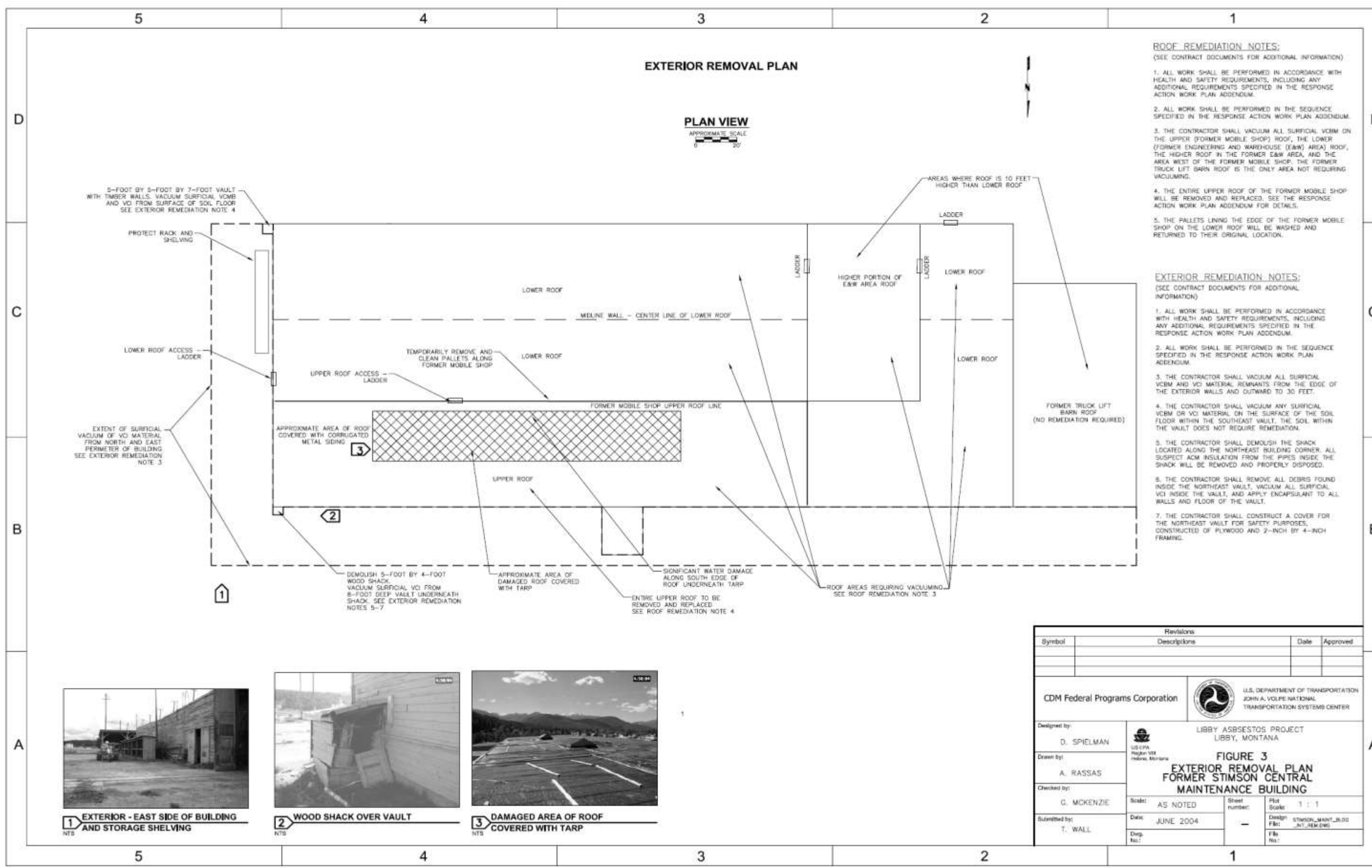
2 INTERIOR BUILDING WALL




3 STEEL GRATE OVER VAULT

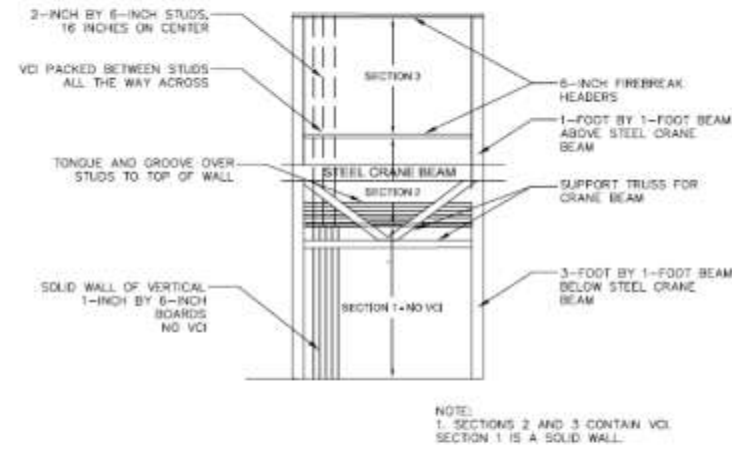
Revisions			
Symbol	Descriptions	Date	Approved

CDM Federal Programs Corporation		U.S. DEPARTMENT OF TRANSPORTATION JOHN A. VOLPE NATIONAL TRANSPORTATION SYSTEMS CENTER	
Designed by:	D. SPIELMAN	LIBBY ASBESTOS PROJECT LIBBY, MONTANA FIGURE 2 INTERIOR REMOVAL PLAN FORMER STIMSON CENTRAL MAINTENANCE BUILDING	
Drawn by:	A. RASSAS		
Checked by:	G. MCKENZIE		
Submitted by:	T. WALL		
Scale:	AS NOTED	Sheet number:	Plot Scale: 1 : 1
Date:	JUNE 2004	Design File:	STIMSON_MANT_BLDG
Drawn by:		File No.:	

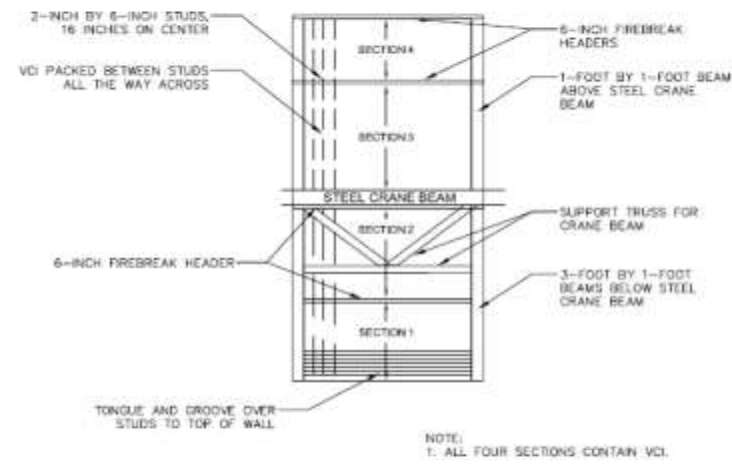


Revisions			
Symbol	Descriptions	Date	Approved
CDM Federal Programs Corporation		 U.S. DEPARTMENT OF TRANSPORTATION JOHN A. VOLPE NATIONAL TRANSPORTATION SYSTEMS CENTER	
Designed by:	D. SPIELMAN	 LIBBY ASBESTOS PROJECT LIBBY, MONTANA FIGURE 3 EXTERIOR REMOVAL PLAN FORMER STIMSON CENTRAL MAINTENANCE BUILDING	
Drawn by:	A. RASSAS		
Checked by:	G. MCKENZIE		
Submitted by:	T. WALL		
Scale:	AS NOTED	Sheet number:	Plot Scale: 1" = 1'
Date:	JUNE 2004	Design:	STIMSON_MAINT_BLDG
Drawn No.:		File:	INT_REM.DWG
		File No.:	

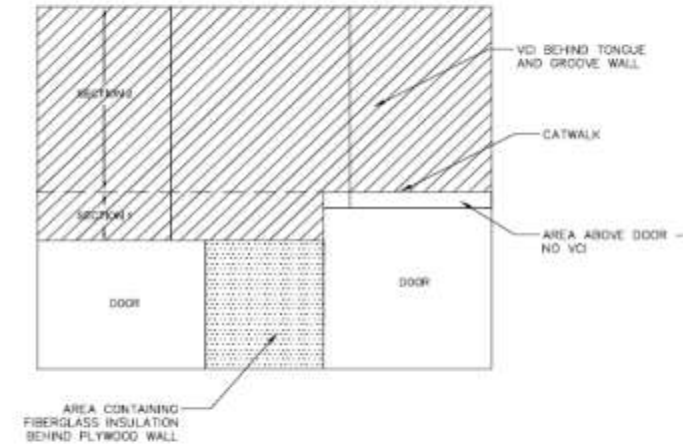
TYPICAL SOUTH WALL BAY DETAIL WITHOUT DOORS



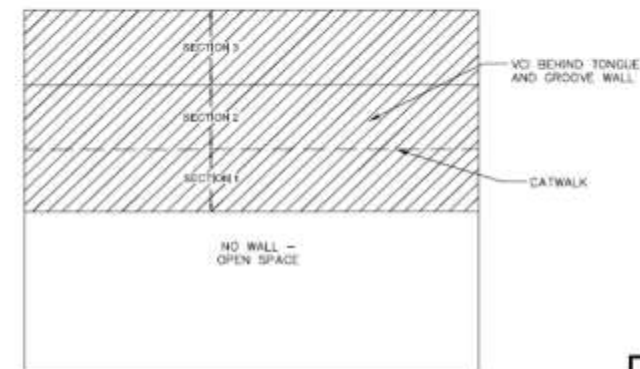
TYPICAL NORTH WALL BAY DETAIL WITHOUT DOORS



EAST WALL DETAIL



WEST WALL DETAIL



Revisions			
Symbol	Descriptions	Date	Approved

CDM Federal Programs Corporation		 U.S. DEPARTMENT OF TRANSPORTATION JOHN A. VOLPE NATIONAL TRANSPORTATION SYSTEMS CENTER	
Designed by:	D. SPIELMAN	LIBBY ASBESTOS PROJECT LIBBY, MONTANA	
Drawn by:	A. RASSAS	 US EPA Region VII Indiana, Michigan	
Checked by:	G. MCKENZIE	FIGURE 4 FORMER MOBILE SHOP WALL DETAILS	
Submitted by:	T. WALL	Scale:	AS NOTED
		Date:	MAY 2004
		Sheet number:	1
		Plot Scale:	1 : 1
		Design File:	STIMSON_MAINT_RLDG
		File No.:	DETAILS.DWG

**Removal and Restoration Completion Form
For Quick Response Action at
Lincoln County Port Authority Property
Central Maintenance Building
Stinger Welding, Inc.
60 Port Boulevard
Libby, Montana**

2010 Q 1/29/13 2010 Q 1/29/13

Between January 12, 2009 and January 13, 2009, quick response removal and restoration activities took place at 60 Port Boulevard (Lincoln County Port Authority, Central Maintenance Building/Stinger Welding, Inc). Activities were conducted in accordance with the Response Action Work Plan (RAWP) (CDM Federal Programs Corporation [CDM] 2008a), and the Response Action Sampling and Analysis Plan (CDM 2008b), forthwith referred to as the Contract Documents. This Removal and Restoration Completion Form summarizes cleanup activities that took place at the property.

1.0 Removal and Restoration Activities

1.1 Interior

Vermiculite-containing Insulation Removal

Vermiculite-containing insulation was removed from the east end of the Central Maintenance Building where a door access was extended. Wall covering was removed and properly disposed. Following the removal, cracks, gaps, and wall cavities around the access area were sealed in accordance with Contract documents. The area was inspected to confirm it was cleaned to standards established by the U.S. Environmental Protection Agency (EPA).

Interior Cleaning

Based on visual inspection, an interior cleaning was conducted in the area of the east door access. Following the interior cleaning, the interior space was inspected to confirm the area was cleaned to standards established by the EPA.

Vermiculite-containing Wall Insulation

Vermiculite-containing insulation remains in the interior walls and exterior walls of the building. Existing openings in these areas were sealed. The EPA strongly recommends that the material be left alone and not disturbed. Should it be necessary to access these areas in the future (such as during renovation), the property owner is encouraged to refer to the guidance included in the post-cleanup completion packet. These publications are also available at the EPA Information Center (108 East 9th Street) and online at <http://www.epa.gov/region8/superfund/libby/inhome.html>.

2.0 References

CDM. 2008a. Response Action Work Plan, EPA Libby Asbestos Project, Libby, Montana. February.

_____. 2008b. Response Action Sampling and Analysis Plan, EPA Libby Asbestos Project, Libby, Montana. April.

I acknowledge that I have received a copy of the Quick Response Statement of Work for the property and that the removal and restoration activities were performed as discussed and agreed upon prior to the cleanup.



Owner

1-26-2010
Date

**Removal and Restoration Completion Form
for Response Action at
Lincoln County Port Authority Property
875 U.S. Highway 2 CMB
Libby, Montana**

RE: EPA Property ID: AD-000686

Between October 10, 2012 and October 16, 2012, removal and restoration activities took place at 875 U.S. Highway 2 (Lincoln County Port Authority property). Activities were conducted in accordance with the Contract Documents. This Removal and Restoration Completion Form summarizes removal activities that took place at the property.

1.0 Removal and Restoration Activities

1.1 Interior

Vermiculite-Containing Insulation Removal

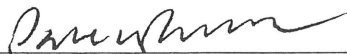
Vermiculite-containing insulation was removed from the wall space. Following the removal, existing gaps and openings on the interior wall were sealed using expansive foam and silicone caulking to minimize the potential for material sifting. Encapsulant was installed in area to minimize the potential for vermiculite-containing insulation fibers to be released. The space was inspected and air clearance samples were collected to confirm the area was cleaned to removal standards established by the U.S. Environmental Protection Agency (EPA). The removed insulation was replaced unless otherwise stated in the Contract Documents.

Interior Cleaning

Based on visual inspection, an interior cleaning was conducted in the area.

Restoration of the disturbed areas was not performed as part of the scope of work for this response action.

I acknowledge that I have received a copy of the Final As-Built Drawings for the property. Removal and restoration activities were discussed and agreed to prior to initiation of removal activities and that the landscape was replaced according to agreed upon terms.



Name

1-29-2013

Date



Memorandum

To: Rebecca Thomas, EPA RPM

From: Dominic Pisciotta

Date: February 27, 2012

*Subject: Operable Unit 5 Central Maintenance Building Summary Report
Memorandum*

This memorandum was produced to summarize specific events which took place to facilitate the cleaning of areas identified as needing response actions, following roof removal activities on the central maintenance building at Operable Unit 5 by U.S. Army Corps of Engineers (USACE) contractors.

1.0 Roof Removal

The property owner's contractor began work to remove Class II asbestos containing material (ACM) from the roof of the central maintenance building on October 10, 2010. Removal of Class II ACM on the roof was completed on September 12, 2011. On September 30, 2011 the Libby area environmental resource specialist (ERS) under the direction of the EPA submitted a statement of work (SOW) detailing the cleaning of four interior areas. These areas were identified as having been impacted by debris from activities associated with the roof removal work.

2.0 Interior Cleaning and Sampling Activities

On November 8, 2011 USACE contractors performed a preparatory inspection and tailgate meeting to discuss and review the ERS SOW. Rooms identified as needing a response action by USACE contractors were Area A (17-2), Area B (11-1), Area C (10-1, 11-2), and Area D (4-1) (see attached map).

Set up activities began November 9, 2011 on the rooms identified as needing a response action. In addition, during set up it was recognized that room 11-2 shared airspace with 10-1 and would require cleaning as well. It was decided between third-party quality assurance (TQA) personnel and the removal contractor (RC) interior foreman that room 11-2 would be combined within the same negative pressure enclosure (NPE) as 10-2. Detail cleaning work began by the RC on the afternoon of November 9, 2011. Cleaning continued on November 10 and 11, 2011.

TQA performed air clearance activities in Area C on November 11, 2011. On November 14, 2011 air clearance results on Area C were reported back by the analytical laboratory as being unable to be read due to overloading of sample media. Work activities of the tenants in an adjoining portion of the building were believed to have caused the overloading due to diesel particulate emissions and welding activities in the vicinity. In an attempt to avoid the impacts of the adjoining tenants, NPE's were then re-configured in a manner so that make up air was drawn from the outside of the building so as to assist in allowing cleaner make up air to enter the NPE. Cleaning continued in Areas A, B, C, and D.

On November 15, 2011 air clearance samples were collected in Areas B and C. Air clearance results on Areas B and C were reported back by the analytical laboratory that the air samples were unable to be read due to overloading.

On November 16, inspections were again performed by TQA and QC personnel to determine the cause of clearance sample failures. The cause of the failures was determined to be exhaust fumes located inside the building, at which time USACE representatives were notified. An agreement was made between the tenants (Thompson Construction Inc.), the property owner, and the government that the tenant would vacate the building on November 18, 2011. This was done so that the building would not be exposed to exhaust fumes and enable the RC to perform an interior cleaning of each room and allow air clearance sampling to follow.

On November 18, 2011 the RC performed the additional cleaning in Areas A, B, C, and D. However, contrary to the agreement noted above, Thompson Construction Inc. began using kerosene heaters and moved a machine into the shop area, again filling the area with exhaust fumes. The issue was reported to USACE and direction was made to not run air clearance due to the exhaust and additional shop activities by Thompson Construction Inc. TQA was directed by the EPA and USACE to perform a visual inspection following additional cleanings of all the NPE's. Upon inspection, TQA requested that the RC perform additional cleaning in Area A. Area A was not sampled to this date due to the decision by EPA and USACE to clear rooms by visual inspection. Following the final visual inspection as directed by the EPA and USACE of all areas, TQA determined that all areas were sufficiently cleaned. NPE's were disassembled and the RC began demobilization. All work was completed at the site on November 18, 2011.

On January 26, 2012 government representatives Dominic Pisciotto (CDM Smith) and Eric Romero (PRI-ER) met with the property manager in order to review and sign final completion documents. The activities associated with the response actions performed were discussed and the property manager stated he had reservations regarding not having air clearance sample results as outlined in the original work plan.

Based on the property managers concerns, CDM Smith made recommendations to the EPA and USACE to have the overloaded samples for Areas B and C analyzed by indirect preparation and base future decisions of removal activities on the results of those samples.

On January 31, 2012 the samples for Areas B and C were re-analyzed by indirect preparation. The results of those samples were as follows:

- Area B - 1 Libby amphibole asbestos (LA) structure detected
- Area C - Non-detect (ND) for LA

Decisions were made by the EPA and USACE to remobilize to the site, set up NPE in Areas A and B, perform cleaning in both areas, and perform air clearance samples according to project protocol. In addition, both clearance sets would be analyzed under normal project standards. If either or both samples were overloaded, they would then be analyzed by indirect preparation. No further action would be taken in Area C due to the results of analysis by indirect preparation were ND for LA

On February 13, 2012 a meeting was held with the property manager, tenant, PRI-ER, CDM Smith, USACE, and EPA to discuss the work needed to be performed as part of further response actions. All parties agreed on dates when work could be performed and that the areas adjacent to the impacted areas would not have any operations involving the use of diesel engines, salamander heaters, or any actions which would compromise the ability for EPA/USACE contractors to perform cleaning and sampling in the impacted areas.

On February 17, 2012 USACE contractors mobilized to the site, set up NPE's in Areas A and B, and performed cleanings in both areas. The cleaning was completed in Areas A and B the afternoon of February 17. Air clearance samples were collected in Areas A and B on February 18, 2012. On February 21, 2012 the analytical results from the air clearance samples for both Areas A and B were reported back by the analytical laboratory as being ND for LA. NPE's were then dissembled and PRI-ER communicated the results of the air clearance samples to the property manager.

875 US Highway 2
AD-000686
Central Maintenance Building
ERS - 9/28/11
C. Peltier

PLAN VIEW
APPROXIMATE SCALE
0 20'

AREA C
Interior Cleaning in
room 10-1, Area
should be
accessed through
11-2

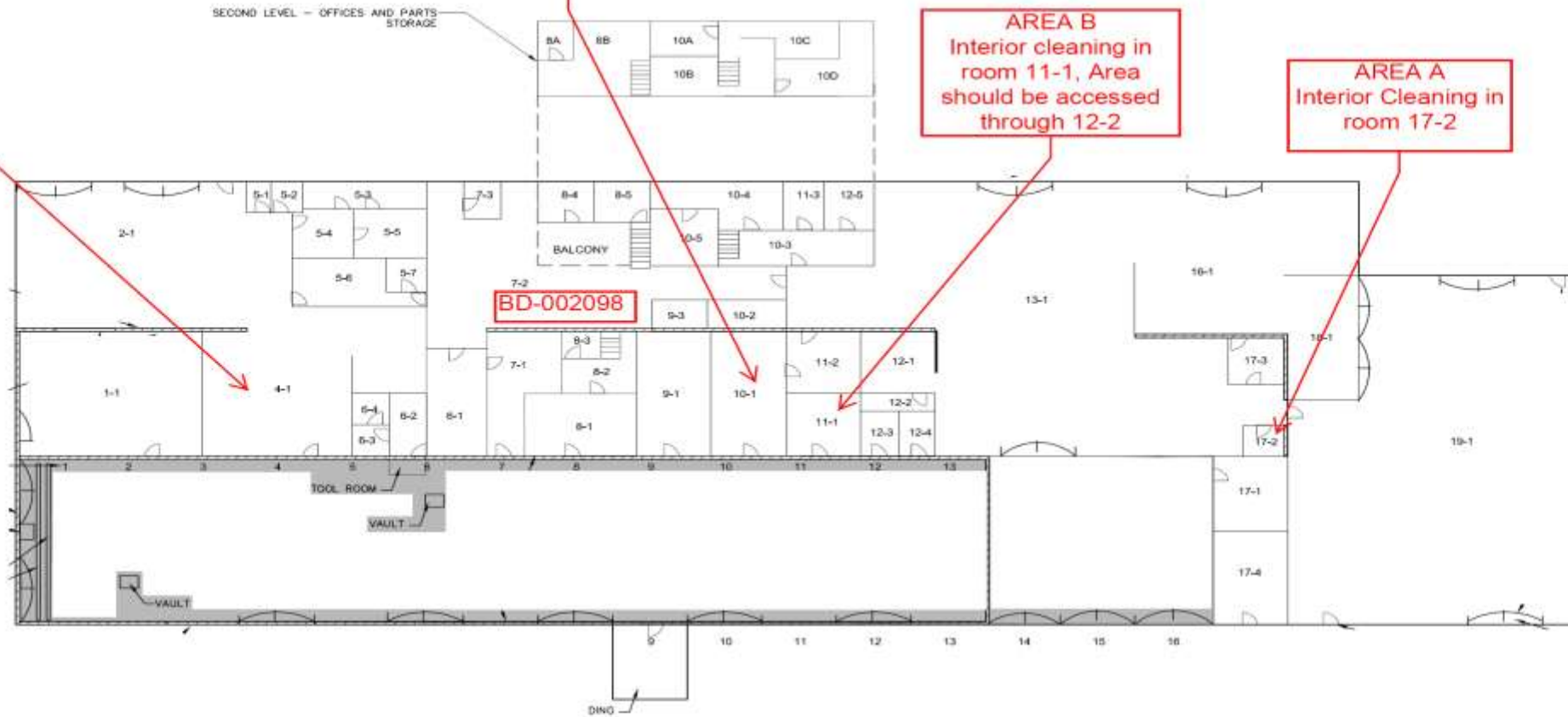
AREA B
Interior cleaning in
room 11-1, Area
should be accessed
through 12-2

AREA A
Interior Cleaning in
room 17-2

AREA D
Debris disposal in
room 4-1, Area
should be accessed
through Stinger
shop

SECOND LEVEL - OFFICES AND PARTS
STORAGE

BD-002098



Appendix A3
Libby and Troy Creek Investigation
Summary Memo



Memorandum

To: Mark Raney

From: C. Tyler Irwin, Nick Raines

Date: November 7, 2008

Subject: Summary of Creek Investigations Completed for Libby Asbestos Superfund Site Operable Units 4 and 7, October 2008

1.0 Overview of Investigation

EPA tasked the US Department of Transportation, John A. Volpe National Transportation Systems Center (Volpe) with the investigation of several area creeks within Operable Unit 4 (OU4) in Libby, Montana and Operable Unit 7 (OU7) in Troy, Montana. The purpose of this investigation was to evaluate the presence or absence of suspect Libby Amphibole (LA) in material used for the construction of riprap in the creeks. The purpose and plan for the investigation are discussed in further detail within *Libby and Troy Creek Investigation Memo, October 2008*.

Granite Creek and Flower Creek in Libby and Callahan Creek in Troy were previously investigated in May 2008. The October 2008 investigations included Libby Creek (Cr), Parmenter Cr, Pipe Cr, Doak Cr, Bobtail Cr, Cedar Cr, and Quartz Cr in Libby (Figure 1), and Lake Cr, Iron Cr, and Brien Cr in Troy (Figure 2). All creeks are perennial streams and experience significant flow fluctuations during the spring and following heavy precipitation events. As a result, the creeks have had riprap placed at various sections by the US Army Corps of Engineers (USACE), Lincoln County, the City of Libby, and/or private land owners to control erosion. Each listed creek was investigated near overpasses, bridges, and along roadways, in residential backyards, and other populated areas. The estimated lengths of each investigated creek are listed below.

Troy

Lake Cr (Kootenai River Section)	1.1 miles
Lake Cr (Mid Section)	0.12 mile
Lake Cr (Overpass Section)	0.12 mile
Iron Cr	0.95 mile
Obrien Cr	0.2 mile

Libby

Libby Cr	6.7 miles
Libby Cr (Hammer Rd Section)	0.19 mile
Parmenter Cr	1.9 miles

Pipe Cr (Lower Section)	1 mile
Pipe Cr (Upper Section)	2 miles
Doak Cr	0.19 mile
Bobtail Cr	0.57 mile
Cedar Cr	0.6 mile
Quartz Cr	1.1 miles

Material used for the construction of riprap sections in the creeks included: 1) quarried argillite and siltstone (metasediments) from the Wallace Formation (Fm) of the Precambrian Belt Group, 2) quarried syenite from the Rainy Creek ultramafic complex, 3) basalt, and 4) concrete debris, tree stumps, wood lagging. The syenite is exposed at the Vermiculite Mountain Mine, and riprap constructed with this material is thought to have originated at the mine. LA material in the form of biotite pyroxenite, magnetite pyroxenite, and LA are often found in the presence of the syenite.

Results of the investigations are summarized in the sections below. Estimated volumes of individual sections that contain syenite and LA material are presented in Table 1.

2.0 Results of Creek Investigation Program

2.1 Introduction

Syenite and LA material were not identified in any of the Troy area creeks, and only in two Libby area creeks during the October 2008 investigation. A description of the occurrence of syenite and LA material in the Libby area creeks follows.

2.2 Pipe Creek (Lower Section)

A 1-mile section of Pipe Cr, beginning at the Kootenai River, was investigated on October 13, 2008 (Figure 1). Riprap material in this section of Pipe Cr is composed of metasediments and basalt except for riprap located at two residential properties on the northern bank of Pipe Cr, between Kootenai River Rd and Botham Drive (Figure 3).

Riprap located on both of these properties is composed of quarried syenite and a smaller volume of metasediments ranging in size from cobbles to boulders. The largest pieces of syenite are approximately 3 feet (ft) in length, averaging approximately 18 inches (in). The syenite locally contains LA material as fracture coatings on syenite. The fracture coatings are the most prevalent form and appear as small radiating, fibrous aggregates, light blue-gray to dull silver in color, similar to LA material observed in Libby Cr.

The riprap at 3623 Kootenai River Rd (PC-01 to PC-02) was placed in a curved, linear exposure (10 ft in total lateral extent) and is approximately 200 ft in length. The riprap at 3737 Kootenai River Rd (PC-03 to PC-04) has similar placement and is approximately 300 ft in length. The riprap at both locations is weathered and often discontinuous with indications of downstream mobilization of components due to erosion.

The locations of these two sections were surveyed with a Trimble GPS unit.

Field sketches of cross-sections of these two locations were not created due to the inconsistent and discontinuous distribution of the material. Further survey activities may be required to fully detail the physical layout of these sections of rip-rap.

2.3 Libby Creek

A 6.7-mile section of Libby Cr, extending from the Kootenai River to near Farm to Market Road (F-M Rd) on the south end of the section was investigated on October 9, October 10, and October 20, 2008 (Figure 1). All riprap material in this section of Libby Cr is composed of metasediments, basalt, and concrete debris, except for a small exposure of riprap located on the eastern bank of the creek, approximately 700 ft south of the Champion Haul Rd bridge (Figure 4).

This riprap section (LC-01 to LC-02) is composed of quarried syenite. The largest pieces are approximately 3 ft in length, averaging approximately 18 in. The syenite locally contains weathered xenoliths of magnetite pyroxenite and biotite pyroxenite. LA material is present in this riprap, and occurs most commonly as fracture coatings on syenite. The fracture coatings appear as small radiating, fibrous aggregates that are light blue-gray to dull silver in color. The LA is soft and has been weathered.

The riprap at this section was placed in a linear exposure (15 ft in lateral extent) and is approximately 300 ft in length. This riprap was deposited in layers. The bottom of the syenite layer (approximately 5 ft height) occurs near the water line and is covered by a 5-ft layer of basalt. The riprap is consolidated with no obvious indication of downstream mobilization of large components due to erosion.

The location of this section was surveyed with a Trimble global positioning system (GPS) unit.

A field sketch of the cross-section at this location was created in the field log notes and is available upon request. Further survey activities may be required to fully detail the physical layout of these sections of rip-rap.

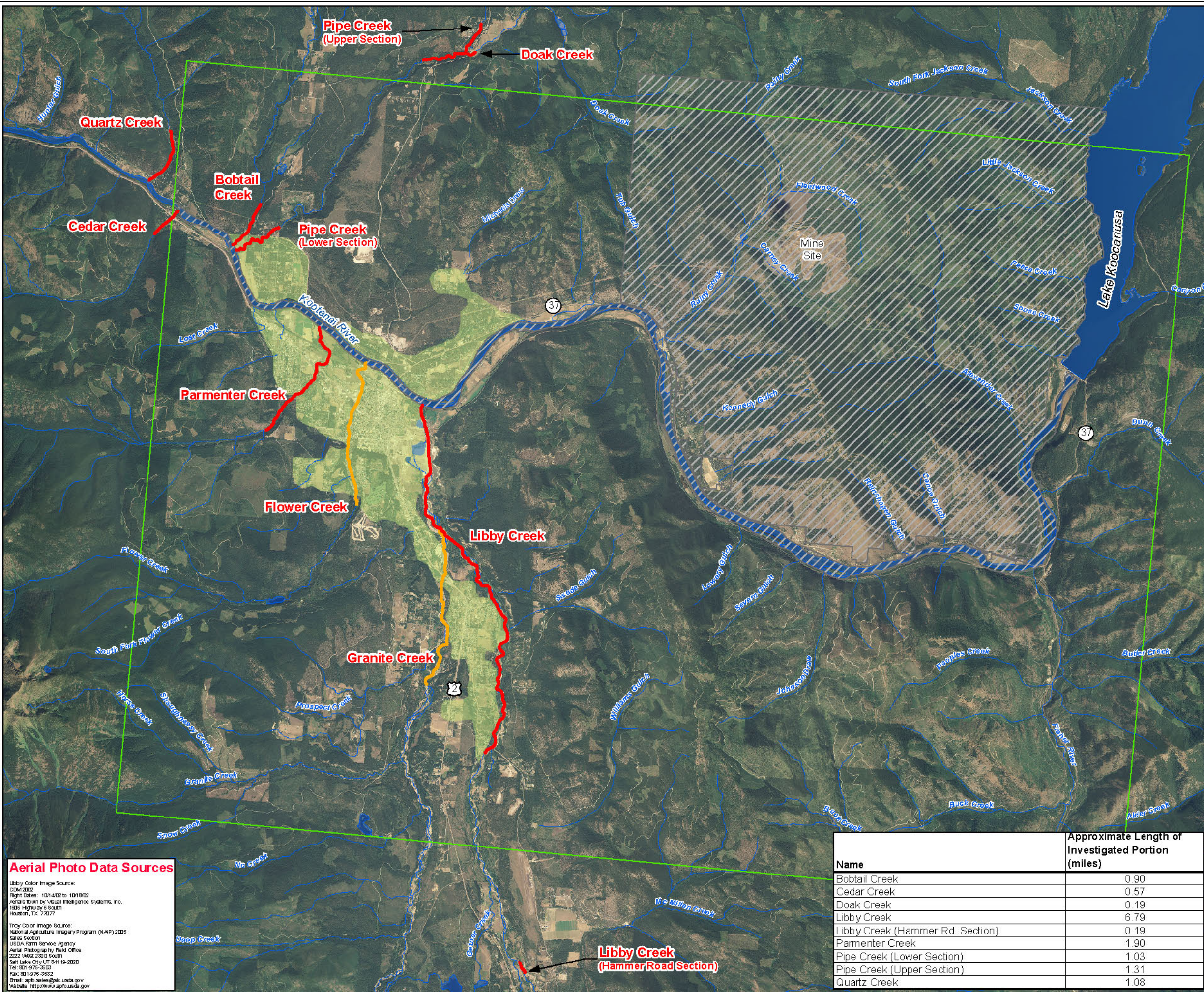
3.0 Summary

Several creeks in the Libby and Troy areas were investigated to evaluate the presence and extent of LA material used for the construction of riprap. Riprap material at one section of Libby Cr and two sections of Pipe Cr includes quarried syenite, which is thought to have originated at the Vermiculate Mountain Mine. The syenite contains LA in the form of weathered fracture coatings. The three occurrences of syenite and LA material are listed below with location designations and estimated volumes.

Table 1 - Summary of Estimated Volumes of Riprap containing LA		
CREEK	STATION	VOLUME (bank cubic yards)
Libby Creek	LC-01 to LC-02	1,000*
Pipe Creek	PC-01 to PC-02	200
	PC-03 to PC-04	200

*Not including overlying basalt

C:\GIS_projects\libby\Troy_Libby_StreamInvestigation\libbyAreaStreamInvestigation_11x17size_rev081027.mxd



Aerial Photo Data Sources

Libby Color Image Source:
CDM 2002
Flight Dates: 10/14/02 to 10/18/02
Aerials flown by Visual Intelligence Systems, Inc.
4202 Highway 6 South
Houston, TX 77077

Troy Color Image Source:
National Agriculture Imagery Program (NAIP) 2005
Sales Section
USDA Farm Service Agency
Aerials Photographed by Field Office
2222 West 23rd South
Salt Lake City UT 84119-2020
Tel: 801-976-3600
Fax: 801-976-3632
Email: apf.sales@fs.fda.gov
Website: <http://www.apf.fda.gov>

Name	Approximate Length of Investigated Portion (miles)
Bobtail Creek	0.90
Cedar Creek	0.57
Doak Creek	0.19
Libby Creek	6.79
Libby Creek (Hammer Rd. Section)	0.19
Parmenter Creek	1.90
Pipe Creek (Lower Section)	1.03
Pipe Creek (Upper Section)	1.31
Quartz Creek	1.08

Canada

Idaho

Wyoming

North Dakota

South Dakota

Montana

Troy

Libby

Creeks/Rivers

Portion of Creek Investigated

Portion of Creek Investigated Previously

OU4 Boundary

OU3 Boundary

Lake

Populated Areas

Miles

0 1 2 4

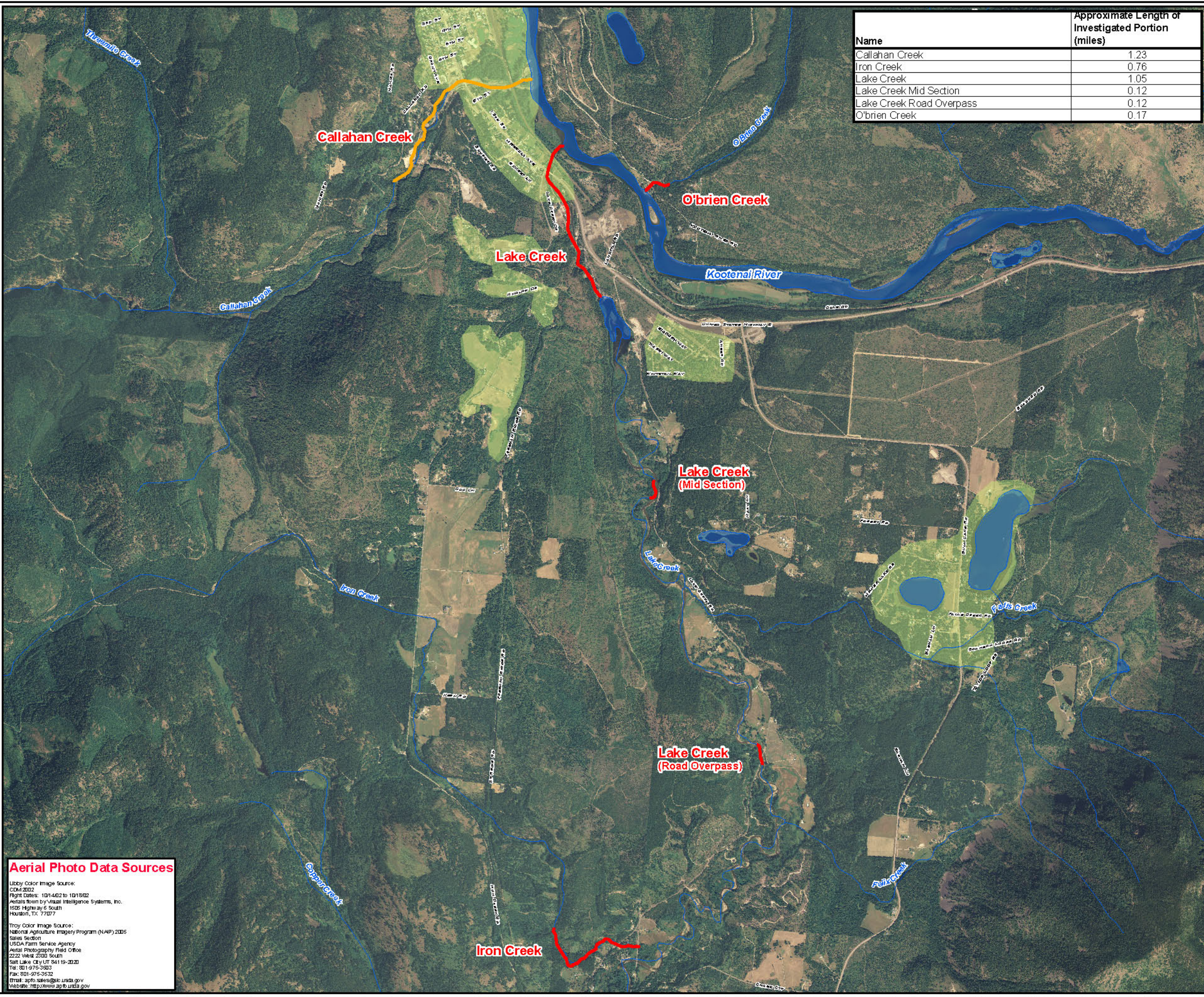
1 inch equals 1.5 miles

DRAFT - For Official Use Only

Figure 1

OU4 Creek Investigations
Libby Asbestos Site
Libby, Montana

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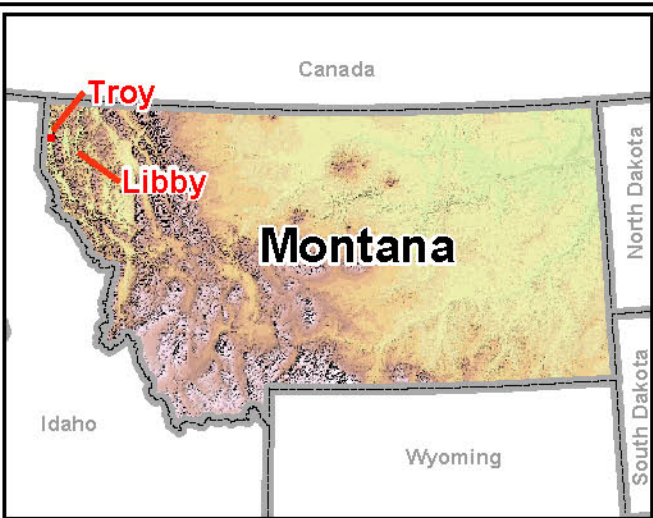


Name	Approximate Length of Investigated Portion (miles)
Callahan Creek	1.23
Iron Creek	0.76
Lake Creek	1.05
Lake Creek Mid Section	0.12
Lake Creek Road Overpass	0.12
O'Brien Creek	0.17

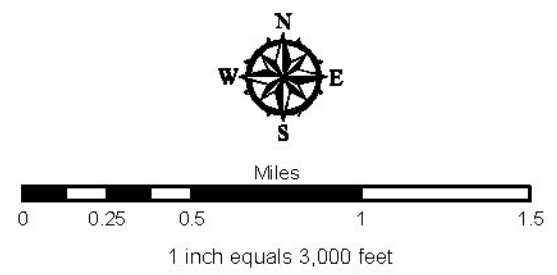
Aerial Photo Data Sources

Libby Color Image Source:
CDM 2002
Flight Dates: 10/14/02 to 10/18/02
Aerials flown by Visual Intelligence Systems, Inc.
1522 Highway 6 South
Houston, TX 77077

Troy Color Image Source:
National Agriculture Imagery Program (NAIP) 2005
Sales Section
USDA Farm Service Agency
Aerial Photography Field Office
2225 West 20th South
Salt Lake City UT 84119-2020
Tel: 801-975-3503
Fax: 801-975-3532
Email: apfo.sales@fs.usda.gov
Website: <http://www.apfo.usda.gov>



- Creeks/Rivers
- Portion of Creek Investigated
- Portion of Creek Investigated Previously
- Lake
- Populated Areas



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Figure 2

Troy Area Creek Investigations
Libby Asbestos Site
Libby, Montana

CDM

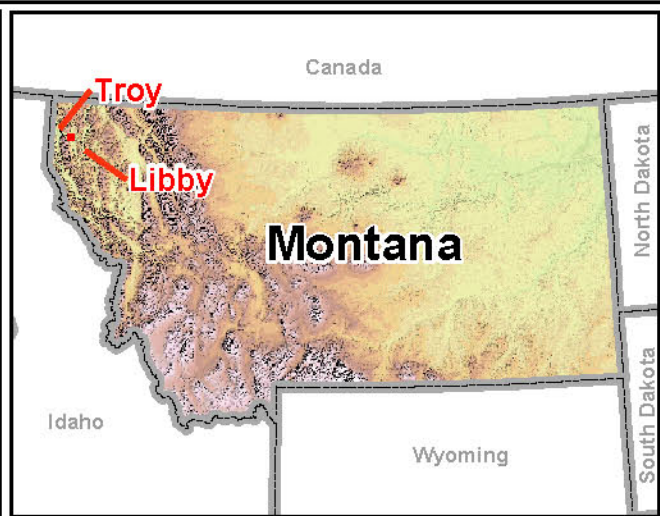
C:\GIS_projects\libby\Troy_StreamInvestigations\PipeCreekLower_RemSites_11x17size_rev081027.mxd



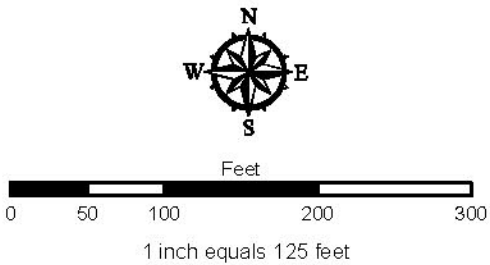
Aerial Photo Data Sources

Libby Color Image Source:
CDM 2002
Flight Dates: 10/14/02 to 10/18/02
Aerials flown by Visual Intelligence Systems, Inc.
1502 Highway 6 South
Houston, TX 77077

Troy Color Image Source:
National Agriculture Imagery Program (NAIP) 2005
Sales Section
USDA Farm Service Agency
Aerial Photography Field Office
2222 West 20th South
Salt Lake City UT 84119-2020
Tel: 801-975-3503
Fax: 801-975-3532
Email: apfo.sales@fs.usda.gov
Website: <http://www.apfo.usda.gov>



- Areas Requiring Remedial Action
- ~~~~~ Portion of Creek Investigated



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Figure 3

Pipe Creek (Lower Section)
Remediation Areas
Libby Asbestos Site
Libby, Montana

CDM

C:\GIS_projects\libby\Troy_Libby_StreamInvestigations\LibbyCreek_RemSites_11x17size_rev081027.mxd



Aerial Photo Data Sources

Libby Color Image Source:
CDM 2002
Flight Dates: 10/14/02 to 10/18/02
Aerials flown by Visual Intelligence Systems, Inc.
1525 Highway 6 South
Houston, TX 77077

Troy Color Image Source:
National Agriculture Imagery Program (NAIP) 2005
Sales Section
USDA Farm Service Agency
Aerial Photography Field Office
2225 West 20th South
Salt Lake City UT 84119-2020
Tel: 801-975-3503
Fax: 801-975-3532
Email: apto.sales@fs.usda.gov
Website: <http://www.apfb.usda.gov>

Canada

Troy

Libby

Montana

Idaho

Wyoming

North Dakota

South Dakota

●—● Area Requiring Remedial Action

~~~~~ Portion of Creek Investigated

N

W E S

Feet

0 50 100 200 300

1 inch equals 125 feet

UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

DRAFT - For Official Use Only

Figure 4

Libby Creek  
Remediation Areas  
Libby Asbestos Site  
Libby, Montana

**CDM**

**LIBBY ASBESTOS PROJECT**  
**Property Closeout Checklist (PCC)**  
**Revision 3**

Form Date: 8-3-09Field Logbook No.: 101121 Page No.'s: 19, 15, 4  
101103 8Address: Libby Creek City: LibbyOccupant: NAOwner: State of MontanaOversight Personnel: K. Beaudoin, S. McNallyRemoval Contractor: ERRestoration Contractor: ERAssociated BD Numbers: NAPCC Check Completed by (100% of forms): Maureen Lapine Date: 10/21/09

| Data Item                                                     | Value                                                                                                         |                                                                | Comments                                                   |
|---------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------|
| Type of removal activity<br><i>circle all that apply</i>      | VCI removal<br>Interior cleaning<br><del>Exterior removal</del><br>Building materials<br><u>Other: Riprap</u> |                                                                | Circle all that apply:<br>Quick Response   Partial Removal |
|                                                               | Start                                                                                                         | Finish                                                         |                                                            |
| Interior setup date(s)                                        | NA                                                                                                            | NA                                                             | NA implies interior work not needed                        |
| Interior removal date(s)                                      | NA                                                                                                            | NA                                                             | NA implies interior work not needed                        |
| Interior restoration date(s)                                  | NA                                                                                                            | <del>NA</del><br><del>8-25-09</del><br><del>8-19-09</del>      | NA implies interior work not needed                        |
| Exterior setup date(s)                                        | 8-3-09                                                                                                        | 8-4-09                                                         | NA implies exterior work not needed                        |
| Exterior removal date(s)                                      | 8-4-09                                                                                                        | 8-25-09                                                        | NA implies exterior work not needed                        |
| Exterior restoration date(s)                                  | 8-17-09                                                                                                       | <del>8-25-09</del><br><del>8-19-09</del><br><del>9-10-09</del> | NA implies exterior work not needed<br>09/03/09 to 10/7/09 |
| Total days at property<br>[include weekends]                  | <u>39</u> <sup>32</sup><br><u>to 10/7/09</u>                                                                  |                                                                |                                                            |
| Contaminated material removed<br><i>circle all that apply</i> | <del>Soil</del><br>VCI<br>Other insulation<br>Household items<br>Rubbish/Debris<br><u>Other: Riprap</u>       |                                                                |                                                            |

| Data Item                                                                                                                                                                                         | Value                                                                                                                                                                                                                                                                              | Comments                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| <i>Cubic yards (Yd<sup>3</sup>) of contaminated material removed:</i>                                                                                                                             |                                                                                                                                                                                                                                                                                    |                             |
| Soil                                                                                                                                                                                              | <u>499</u> Yd <sup>3</sup><br>NA                                                                                                                                                                                                                                                   |                             |
| VCI                                                                                                                                                                                               | <u>NA</u> Yd <sup>3</sup>                                                                                                                                                                                                                                                          |                             |
| Other insulation                                                                                                                                                                                  | <u>NA</u> Yd <sup>3</sup>                                                                                                                                                                                                                                                          | Type of insulation removed: |
| Household items                                                                                                                                                                                   | Description:<br><u>NA</u>                                                                                                                                                                                                                                                          |                             |
| Rubbish/Debris                                                                                                                                                                                    | <u>95</u><br>Truckloads<br>NA                                                                                                                                                                                                                                                      | Description: <u>RipRap</u>  |
| Any contaminated material remaining after removal is complete?<br>[responses must be consistent within the shaded sections]                                                                       | No - circle if next two items are circled NA below<br><del>Soil</del> - circle if Contaminated soil remaining is circled below<br>VCI - circle if VCI remaining is circled below                                                                                                   |                             |
| [responses must be consistent within the shaded sections]<br><br>Contaminated soil remaining<br><br>NA<br><br>[When revising this section also revise corresponding item in shaded section above] | Location description:<br><br>Areas A2, A3, A1, <del>A4</del> <sup>m210/2109</sup> had <1% Libby amphibol at 12-14" BGS<br><br><sup>m210/2109</sup><br>Areas <del>A1</del> , A1, B1, A2, A3, B2 had visible vermiculite at 12" BGS<br>Area A5 had visible vermiculite at 48-74" BGS |                             |
| [responses must be consistent within the shaded sections]<br><br>VCI remaining<br><br><del>NA</del><br><br>[When revising this section also revise corresponding item in shaded section above]    | Location description: [include RAWP Addendum background information]                                                                                                                                                                                                               |                             |

### Data Item

Value

## Comments

*Cubic yards (Yd<sup>3</sup>) of material replaced:*

## Insulation

\_\_\_\_\_ Yd<sup>3</sup>

Type:

NA

Residential fill

$$244 \quad \text{Yd}^3$$

NA

Topsoil

\_\_\_\_\_ Yd<sup>3</sup>

NA

Other material (i.e., gravel)

(a) 237, (b) 137  $\text{Yd}^3$

NA (C) 1000

Type: (a)  $\frac{3}{4}$ " minus crushed rock  
(b) 2" minus crushed rock  
(c) Riprap

HEPA vacuum given to resident?

Date: \_\_\_\_\_

Reason:

Not given

Items damaged during construction

- See removal and restoration checklist

☒ None

### ADDITIONAL INFORMATION

## One Amendment Two Mods

LIBBY CREEK  
MONTANA

2R- 07083

> AREA C3  
12-14"

ND

NO VISIBLE

SP- 141276

2R- 07084

> AREA B2  
12-14"

ND  
visible (1 low)

SP- 141277

2R- 07087

> AREA B1  
12-14"

ND  
visible observed  
(1 low)

SP- 141278

2R- 07126

> AREA D1  
12-14"

ND  
resampled as Area D2

SP- 141293

2R- 07133

> AREA A2  
12-14"

< 1%

visible observed  
(7 low)

SP- 141300

2R- 07134

> AREA A3  
12-14"

< 1%  
visible observed  
(6 low)

SP- 141301



CLIENT \_\_\_\_\_  
PROJECT \_\_\_\_\_  
DETAIL \_\_\_\_\_

JOB NO. \_\_\_\_\_  
DATE CHECKED \_\_\_\_\_  
CHECKED BY \_\_\_\_\_

AD-005414  
COMPUTED BY \_\_\_\_\_  
DATE \_\_\_\_\_  
PAGE NO. \_\_\_\_\_

2R- 07509

SP- 141305

> AREA A1  
12-14" BGS

LIBBY CREEK  
21% MONTANA  
2 low visible

2R- 07510

SP- 141306

> AREA A4  
12-14" BGS

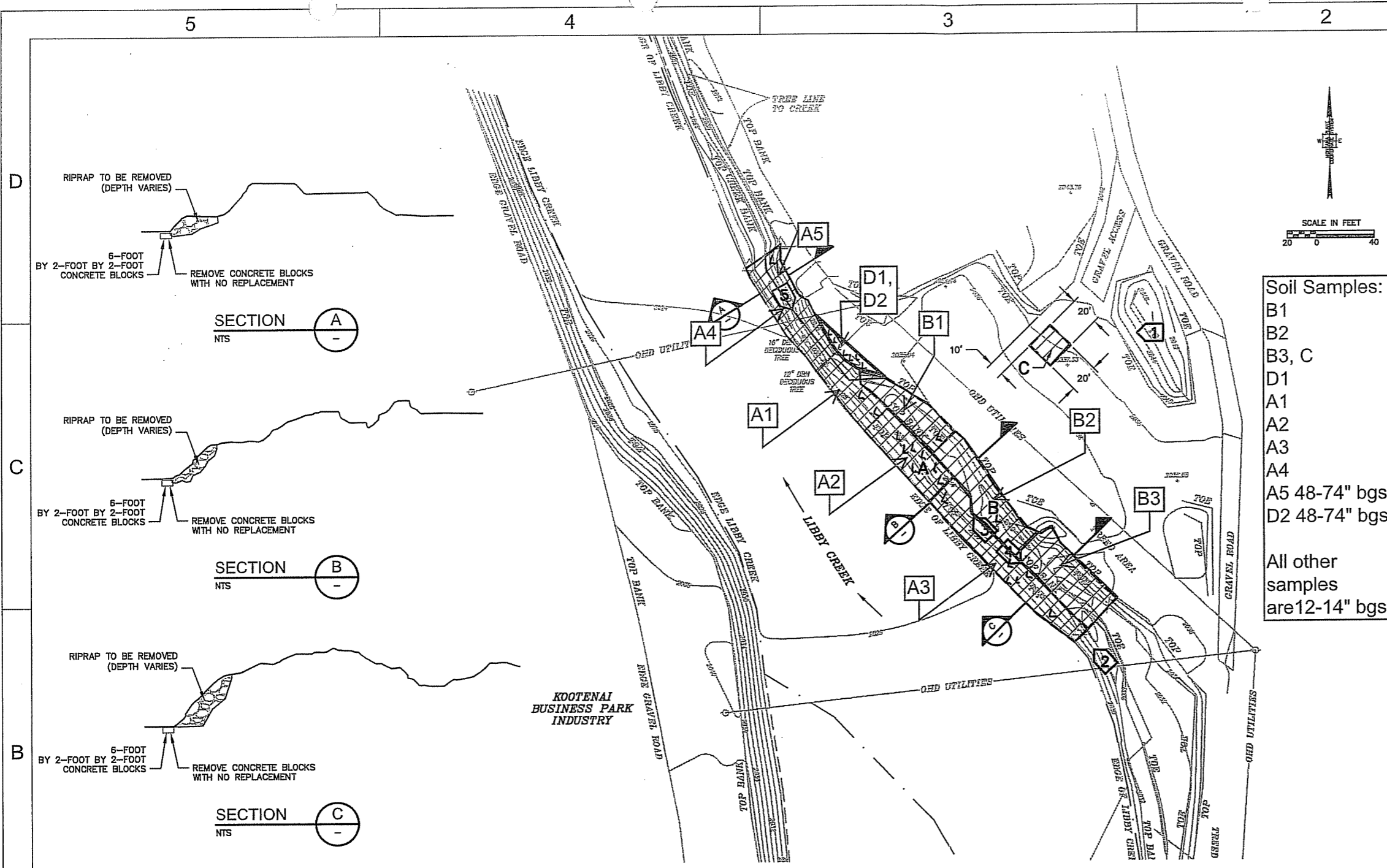
mjr 10/21/09  
41% ND  
no visible

2R- 07273

SP- 140813

> Area A5, D2  
48"-74"

ND  
1 Low visible



- EXTERIOR REMEDIATION NOTES:**  
(REFER TO CONTRACT DOCUMENTS FOR ADDITIONAL INFORMATION)
1. THIS PROPERTY HAS BEEN INSPECTED USING STANDARD OPERATING PROCEDURE CDM LIBBY-06.
  2. THE REMOVAL CONTRACTOR SHALL PERFORM THE WORK WHILE MINIMIZING ENVIRONMENTAL POLLUTION AND DAMAGE AS THE RESULT OF CONSTRUCTION OPERATIONS. THE ENVIRONMENTAL RESOURCES WITHIN THE PROJECT BOUNDARIES AND THOSE AFFECTED OUTSIDE THE CONSTRUCTION LIMITS SHALL BE PROTECTED DURING THE ENTIRE DURATION OF THIS PROJECT.
  3. THE REMOVAL CONTRACTOR SHALL PLACE SAND BAGS WITHIN THE CREEK BED UPSTREAM OF EXCAVATION AREAS ADJACENT TO FLOWING WATER TO MINIMIZE FLOW AND LOCALIZE SEDIMENT TRANSPORTATION.
  4. THE REMOVAL CONTRACTOR SHALL PROVIDE THE WATER SOURCE FOR PERSONNEL AND EQUIPMENT DECONTAMINATION. DECONTAMINATION WATER WILL BE CAPTURED AND DISPOSED OF PROPERLY.
  5. REMOVE ALL RIPRAP FROM THE CREEK BANK (AREA A) IN ADDITION TO 12 INCHES BELOW GROUND SURFACE.

**Soil Samples:**  
B1  
B2  
B3, C  
D1  
A1  
A2  
A3  
A4  
A5 48-74" bgs  
D2 48-74" bgs  
  
All other samples are 12-14" bgs

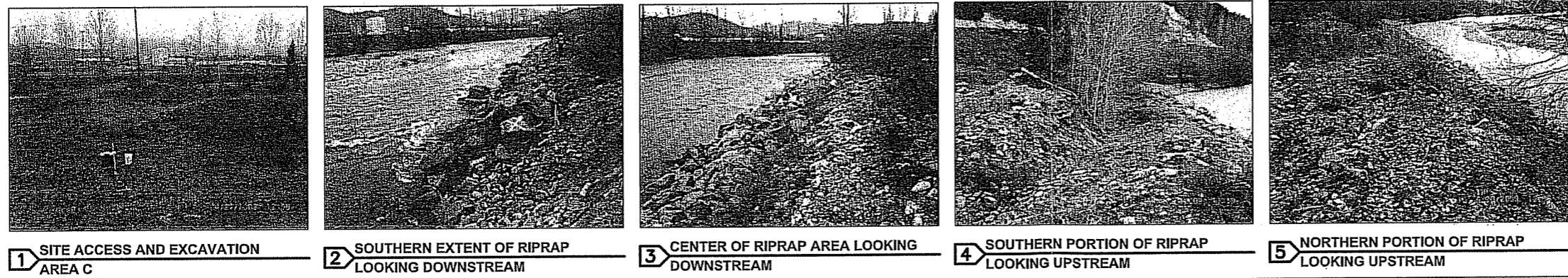
- BEST MANAGEMENT PRACTICE NOTES:**
1. APPROPRIATE EROSION AND SEDIMENT CONTROLS (SILT FENCES, TEMPORARY WATER RETENTION BERMS, ETC.) SHALL BE INSTALLED PRIOR TO THE COMMENCEMENT OF WORK AND SHALL BE MAINTAINED FOR THE DURATION OF REMOVAL ACTIVITIES.
  2. EQUIPMENT SHALL BE PRESSURE WASHED PRIOR TO SITE ENTRY TO PREVENT THE SPREAD OF NOXIOUS WEEDS TO THE REMOVAL AREA.
  3. EQUIPMENT USED NEAR THE WATER SHALL BE CLEANED PRIOR TO CONSTRUCTION.
  4. WORK SHALL BE CONDUCTED DURING A PERIOD OF LOW FLOW.
  5. BIODEGRADABLE HYDRAULIC FLUIDS SHALL BE USED IN MACHINERY WHERE APPROPRIATE.
  6. REFUELING SHALL OCCUR ON THE BACKSIDE OF THE LEVEE OR ON ESTABLISHED STAGING AREAS.
  7. CONSTRUCTION EQUIPMENT SHALL BE REGULARLY CHECKED FOR DRIPS OR LEAKS.
  8. AT LEAST ONE FUEL SPILL KIT WITH ABSORBENT PADS SHALL BE ONSITE AT ALL TIMES.
  9. DRIVE TRAINS OF EQUIPMENT SHALL NOT OPERATE IN THE WATER.

12" BGS EXCAVATION DEPTH

| EXCAVATION QUANTITIES |                         |             |                                    |
|-----------------------|-------------------------|-------------|------------------------------------|
| AREA DESIGNATION      | AREA (ft <sup>2</sup> ) | DEPTH (in.) | IN-PLACE VOLUME (yd <sup>3</sup> ) |
| A                     | 7379                    | 12          | 273                                |
| B                     | 5405                    | 12          | 200                                |
| C                     | 400                     | 12          | 15                                 |
| RIPRAP                | -                       | -           | 1000*                              |
| TOTAL                 |                         |             | 1488*                              |

\* RIPRAP VOLUME IS ESTIMATED BASED ON FIELD MEASUREMENTS AND VISUAL OBSERVATIONS.  
NOTE: REFER TO SHEET C-1 FOR GENERAL NOTES, LEGENDS, MAPS AND OTHER INFORMATION. REFER TO SHEET C-2 FOR DETAILS.

| Revisions                        |                                          |                                                                                           |                   |  |  |
|----------------------------------|------------------------------------------|-------------------------------------------------------------------------------------------|-------------------|--|--|
| Symbol                           | Descriptions                             | Date                                                                                      | Approved          |  |  |
|                                  |                                          |                                                                                           |                   |  |  |
|                                  |                                          |                                                                                           |                   |  |  |
|                                  |                                          |                                                                                           |                   |  |  |
| CDM Federal Programs Corporation |                                          | U.S. DEPARTMENT OF TRANSPORTATION<br>JOHN A. VOLPE NATIONAL TRANSPORTATION SYSTEMS CENTER |                   |  |  |
| Designed by:<br>N. L. SMITH      | LIBBY ASBESTOS PROJECT<br>LIBBY, MONTANA |                                                                                           |                   |  |  |
| Drawn by:<br>M. KUZMAK           |                                          |                                                                                           |                   |  |  |
| Checked by:<br>G. McKENZIE       | LIBBY CREEK<br>REMEDATION PLAN           |                                                                                           |                   |  |  |
| Submitted by:<br>T. WALL         | Scale: AS NOTED                          | Sheet number: 1                                                                           | Plot Scale: 1 : 1 |  |  |
|                                  | Date: JUNE 5, 2009                       | Design File: LIBBY_CREEK.DWG                                                              | File No.:         |  |  |
|                                  | Dwg. No.:                                |                                                                                           |                   |  |  |



1 SITE ACCESS AND EXCAVATION AREA C    2 SOUTHERN EXTENT OF RIPRAP LOOKING DOWNSTREAM    3 CENTER OF RIPRAP AREA LOOKING DOWNSTREAM    4 SOUTHERN PORTION OF RIPRAP LOOKING UPSTREAM    5 NORTHERN PORTION OF RIPRAP LOOKING UPSTREAM

**Appendix A4**  
**Completion Form for a Quick Response**  
**at the Plywood Plant**

**Removal and Restoration Completion Form  
For Quick Response Action at  
Kootenai River Development Property  
875 US Highway 2 (Former Plywood Plant)  
Libby, Montana**

RE: EPA Property ID: AD-000686

Between August 30, 2010 and September 1, 2010, quick response removal and restoration activities took place at 875 US Highway 2 (Kootenai River Development property). This Removal and Restoration Completion Form summarizes cleanup activities that took place at the property.

## **1.0 Removal and Restoration Activities**

### **1.1 Exterior**

Soil was removed along the trenched area north of the former veneer dryer in accordance with the Contract Documents. Confirmation soil samples were collected from this area to verify the contamination was removed to the depth required to meet current U.S. Environmental Protection Agency (EPA) cleanup goals. However, visible vermiculite was observed in the floor of the excavation in the area indicated on the attached map. EPA strongly recommends that it be left alone and not disturbed. If the material is disturbed, the property owner is encouraged to refer to the guidance included in the post-cleanup completion packet. Information about Libby amphibole and vermiculite is also available at the EPA Information Center (108 E. 9<sup>th</sup> Street) and online at <http://www.epa.gov/region8/superfund/libby/inhome.html>.

### **Vermiculite-containing Building Material**

Vermiculite was identified in the mortar and bricks along the perimeter of the former veneer dryers. The vermiculite-containing building materials were removed and disposed of in accordance with the Contract Documents.

I acknowledge that I have received a copy of the Quick Response Statement of Work for the property and that the removal and restoration activities were performed as discussed and agreed upon prior to the cleanup.

  
\_\_\_\_\_  
Owner

11-15-2010  
Date

**Appendix A5**  
**Completion Form for a Quick Response**  
**at the Valve House at Stimson Finger-Joiner Building**

**Removal and Restoration Completion Form  
For Quick Response Action at  
Kootenai River Development Property  
875 US Highway 2 (Valve House at Stimson Finger-Jointer Building)  
Libby, Montana**

RE: EPA Property ID: AD-000686

Between August 18, 2010 and September 7, 2010, quick response removal and restoration activities took place at 875 US Highway 2 (Valve House at Stimson Finger-Jointer Building) (Kootenai River Development property). This Removal and Restoration Completion Form summarizes cleanup activities that took place at the property.

## **1.0 Removal and Restoration Activities**

### **1.1 Exterior**

Soil was removed from the ground area surrounding the valve house and the floor of the valve house, and restored in accordance with the Contract Documents. Confirmation soil samples were collected from these areas to verify the contamination was removed to the depth required to meet current U.S. Environmental Protection Agency (EPA) removal criteria. However, contaminated soil remains at depth in the areas indicated on the attached map. These areas were covered with materials in order to minimize the potential for human exposure. EPA strongly recommends that it be left alone and not disturbed. If the at-depth material is exposed or disturbed, the property owner is encouraged to refer to the guidance included in the post-cleanup completion packet. Information about Libby vermiculite is also available at the EPA Information Center (108 E. 9<sup>th</sup> Street) and online at <http://www.epa.gov/region8/superfund/libby/inhome.html>.

### **1.2 Interior**

#### **Vermiculite-containing Insulation Removal**

Vermiculite-containing insulation was removed from the attic space, walls and ceiling of the valve house. Following the removal, the space was inspected and air clearance samples were collected to confirm the area was cleaned to standards established by the EPA. The removed insulation was replaced unless otherwise stated in the Contract Documents.

#### **Interior Cleaning**

Based on visual inspection, an interior cleaning was conducted in the valve house. Following the interior cleaning, the interior space was inspected and air clearance samples were collected to confirm the area was cleaned to standards established by the EPA.

## Vermiculite-containing Building Material

Vermiculite was identified in the tongue and groove from the walls, door and ceiling of the valve house. The vermiculite-containing building material was removed and disposed of in accordance with the Contract Documents.

I acknowledge that I have received a copy of the Quick Response Statement of Work for the property and that the removal and restoration activities were performed as discussed and agreed upon prior to the cleanup.

  
\_\_\_\_\_  
Owner

11-15-2020  
Date

**Appendix A6**  
**Completion Form for a Quick Response**  
**at the Former Popping Plant on OU5**

**Removal and Restoration Completion Form**  
**For Quick Response Action at**  
**Lincoln County Port Authority Property**  
**875 U.S. Highway 2**  
**Libby, Montana**

**RE: EPA Property ID: AD-000686**

Between August 3, 2011 and November 7, 2011, quick response removal and restoration activities took place at 875 U S Highway 2 (Lincoln County Port Authority property). This Removal and Restoration Completion Form summarizes cleanup activities that took place at the property.

## **1.0 Removal and Restoration Activities**

### **1.1 Exterior**

Soil was removed from the area used for parking and was restored in accordance with the Contract Documents. Confirmation soil samples were collected from this area to verify the Libby amphibole was removed to the depth required to meet current U.S. Environmental Protection Agency (EPA) removal goals. However, soils impacted with vermiculite or Libby amphibole remain at depth in the areas indicated on the attached map. This area was covered with materials in order to minimize the potential for human exposure. EPA strongly recommends that it be left alone and not disturbed. If the at-depth material is exposed or disturbed, the property owner is encouraged to refer to the guidance included in the post-cleanup completion packet. Information about Libby amphibole and vermiculite is also available at the EPA Information Center (108 E. 9<sup>th</sup> Street) and online at <http://www.epa.gov/region8/superfund/libby/inhome.html>.

I acknowledge that I have received a copy of the Removal and Restoration Statement of Work for the property and that the removal and restoration activities were performed as discussed and agreed upon prior to the cleanup.

  
\_\_\_\_\_  
Owner

6-5-2013  
Date

**Appendix A7**  
**Completion Form for a Quick Response**  
**at the Lincoln County Port Authority Property**  
**(CDM Offices)**

**Removal and Restoration Completion Form**  
**For Quick Response Action at**  
**Lincoln County Port Authority Property**  
**875 U.S. Highway 2**  
**Libby, Montana**

**RE: EPA Property ID: AD-000686**


Between April 16, 2012 and May 24, 2012, quick response removal and restoration activities took place at 875 U S Highway 2 (Lincoln County Port Authority property). This Removal and Restoration Completion Form summarizes cleanup activities that took place at the property.

## **1.0 Removal and Restoration Activities**

### **1.1 Exterior**

Soil was removed from a portion of the yard NW of the Lincoln County Port Authority building and restored in accordance with the Contract Documents. Confirmation soil samples were collected from this area to verify the contamination was removed to the depth required to meet current U.S. Environmental Protection Agency (EPA) removal criteria.

I acknowledge that I have received a copy of the Removal and Restoration Statement of Work for the property and that the removal and restoration activities were performed as discussed and agreed upon prior to the cleanup.

  
\_\_\_\_\_  
Owner

1-29-2012  
Date

**Appendix A8**  
**Documentation of Soil Removal Activities**  
**of the Former Tree Nursery**

**Removal and Restoration Completion Form  
For Quick Response Action at  
Lincoln County Port Authority Property  
875 U.S. Highway 2  
Libby, Montana**

**RE: EPA Property ID: AD-000686**

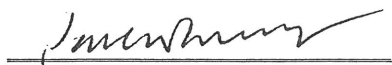
Between June 25, 2012 and July 31, 2012, quick response removal and restoration activities took place at 875 U S Highway 2 (Lincoln County Port Authority property). This Removal and Restoration Completion Form summarizes cleanup activities that took place at the property.

## **1.0 Removal and Restoration Activities**

### **1.1 Exterior**

Soil was removed from the area previously known as the nursery and was restored in accordance with the Contract Documents. Confirmation soil samples were collected from this area to verify the Libby amphibole was removed to the depth required to meet current U.S. Environmental Protection Agency (EPA) removal goals; however, soils impacted with vermiculite or Libby amphibole remain at depth in the areas indicated on the attached map. This area was covered with materials in order to minimize the potential for human exposure.

I acknowledge that I have received a copy of the Removal and Restoration Statement of Work for the property and that the removal and restoration activities were performed as discussed and agreed upon prior to the cleanup.



Owner

1-29-2013

Date



NOTES:

- LOCATIONS ARE APPROXIMATE.
- AREAS REQUIRING REMOVAL HAVE BEEN INDICATED IN THE FIELD USING GREEN FLAGGING.
- EXC ZONE 'B' DOES NOT REQUIRE RESTORATION.
- EXCAVATION IN ZONE 'B' SHALL CONTINUE UNTIL NO VERMICULITE IS OBSERVED IN THE FLOOR OF EXCAVATION AND CLEARANCE SOIL SAMPLE RESULT IS ND.

EXTERIOR REMOVAL NOTES:

(REFER TO REMOVAL AND RESTORATION DOCUMENTS FOR ADDITIONAL INFORMATION)

- IF APPLICABLE, THE ELECTRICITY TO THE HOUSE WILL BE TURNED OFF AS REQUIRED FOR CONSTRUCTION ACTIVITIES. THE CONTRACTOR IS TO SUPPLY, AS NEEDED, A GENERATOR TO SUPPLY ELECTRICITY TO APPLIANCES. PLEASE REFER TO PRI-ER RESTORATION AGREEMENT FOR LOCATIONS OF APPLICABLE ELECTRICAL COMPONENTS.
- UNDERGROUND UTILITIES AND SEPTIC SYSTEMS MAY BE PRESENT ON THE PROPERTY. IF KNOWN, THEY ARE MARKED IN APPROXIMATE LOCATIONS ONLY. PROCEED WITH CAUTION IN ALL EXCAVATION AREAS.
- WHEN SHOWN, LOCATION OF DECONTAMINATION STATIONS AND BREAK AREAS ARE SUBJECT TO CHANGE WITH EXCAVATION CONDITIONS. THESE AREAS WILL NOT CHANGE IN RELATION TO EACH OTHER AND WILL BE PRESENT AT ALL TIMES DURING REMOVAL ACTIVITIES.
- IF APPLICABLE, REMOVE AND DISPOSE OF THE FIRST LAYER OF FIREWOOD IN CONTACT WITH CONTAMINATED SOIL.
- MISCELLANEOUS ITEMS NOT REFERRED TO IN THE RESTORATION AGREEMENT ARE TO BE CLEANED AND STAGED FOR REINSTALLATION.
- SEE ADDITIONAL NOTES ON ATTACHED RRA SYNOPSIS AND PRE FORM(S).

LEGEND

- 12" BGS EXCAVATION DEPTH
- DE-CON AREA
- BREAK AREA
- EXCAVATION ACCESS
- NS NOT INSPECTED/SAMPLED - SEE INVESTIGATION DATA
- NE NO EXCAVATION REQUIRED PER CURRENT REMOVAL CRITERIA

JEREMY AYALA

Digitally signed by  
AYALA JEREMY.A.1403662697  
DN: c=US, o=U.S. Government, ou=DoD,  
ou=PKI, ou=USA,  
cn=AYALA JEREMY.A.1403662697  
Date: 2013.04.15 09:32:58 -05'00'

GOVERNMENT REPRESENTATIVE

DATE

SHEET:

LIBBY ASBESTOS PROJECT  
LINCOLN COUNTY, MONTANA

AD #: 000686

GEOUNIT #: 5730

GRZ #: 00

DRAWING BY/DATE

T. ROBERTSON 03/28/13

QC REVIEW BY/DATE

K. MCKENZIE 04/03/13

DRAWING FINALIZED BY/DATE

T. ROBERTSON 04/12/13

REVISION #:

REVISION DATE:

DESCRIPTION:

0

04/12/13

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

N/A

...\\OU4\\STREET BY NAME\\US HIGHWAY 2\\875 US HIGHWAY 2\\FISHING POND\\CAD\\-FINAL DESIGN-REV 0.DWG

1

OF 2



US EPA  
Region VIII  
Denver, Colorado



US ARMY CORPS OF ENGINEERS  
OMAHA DISTRICT  
RAPID RESPONSE PROGRAM

LINCOLN COUNTY PORT AUTHORITY  
875 US HIGHWAY 2  
EXCAVATION DESIGN

D

C

B

A

# **Appendix B**

## **Sample Phase List**

**Phase 1**

202 field samples (analyzed by TEM-AHERA)  
196 stationary indoor, 4 stationary outdoor, 2 personal outdoor  
Index ID range 1-08051 to 1-09014  
Sample Date range 6/23/2004 to 8/13/2009  
Only 1/202 samples were detect for LA  
1-08592: total LA conc = 0.0046 s/cc

**Phase 1R**

232 field samples (analyzed by TEM-AHERA)  
160 stationary indoor, 53 stationary outdoor, 19 personal indoor  
Index ID range 1R-24496 to 1R-36895  
Sample Date range 1/23/2004 to 6/29/2006  
10/232 samples were detect for LA (20 samples w/o TEM results)  
Total LA conc detects range: 0.0048 s/cc to 1.4 s/cc  
Highest detects were personal air samples during bulk removal  
All detects measured in May-June 2005

**Phase 2R**

21 field samples (analyzed by TEM-AHERA)  
16 stationary indoor, 5 stationary outdoor  
Index ID range 2R-01028 to 2R-05369  
Sample Date range 5/22/2008 to 5/21/2009  
5/21 samples were detect for LA (5 samples w/o TEM results)  
Total LA conc detects range: 0.0048 s/cc to 0.42 s/cc  
All detects measured April 28, 2009 from soil split connex

**Ambient Air Program (AA)**

40 field samples (analyzed by TEM-ISO)  
all stationary outdoor [from one OU5 monitor]  
Index ID range AA-00081 to AA-01721  
Sample Date range 10/4/2006 to 9/21/2007  
8/40 samples were detect for LA (1 sample w/o TEM results)  
Total LA conc detects range: 3.6E-05 s/cc to 1.6E-04 s/cc

**SQAPP ABS Sampling Program (SQ)**

20 field samples (analyzed by TEM-ISO)

12 stationary outdoor, 8 personal outdoor [3 activities \* 2 ABS areas]

Index ID range SQ-00041 to SQ-00134

Sample Dates 6/21/2005 (ND ABS area), 6/25/2005 (Tr ABS area)

6/20 samples were detect for LA

Total LA conc detects range: 9.6E-04 s/cc to 0.0010 s/cc

**Stimson Lumber Programs (SL)**

456 field samples (analyzed by TEM-ISO, +AHERA for some)

103 stationary indoor, 150 personal indoor, 20 stationary outdoor, 183 personal outdoor

Index ID range SL-00001 to SL-70815

Sample Date range 9/10/2002 to 9/18/02 and 10/10/07 to 10/2/2008

111/456 samples were detect for LA (1 sample w/o TEM results)

Total LA conc detects range: 3.8E-04 s/cc to 0.16 s/cc

*Index ID Summary:*

**SL-00001 to SL-00245 (not sequential):**

monitoring of Stimson Lumber site workers (9/10/02 to 9/18/02)

N = 124 personal samples analyzed by ISO and AHERA

N = 38 stationary samples analyzed by ISO and AHERA

**SL-00300 to SL-00339, SL-00420 to SL-00422: MotoX ABS**

N = 24 personal samples analyzed by ISO (9/10/08 and 9/17/08)

N = 10 stationary samples analyzed by ISO (9/10/08 and 9/17/08)

**SL-00340 to SL-00407: RecVis Biking ABS**

N = 46 samples analyzed by ISO (9/16/08 to 9/19/08)

**SL-00408 to SL-00418, SL-00424 to SL-00601: Outdoor Worker ABS**

N = 48 samples analyzed by ISO (9/23/08 to 10/2/08)

**SL-70120 to SL-70258 (not sequential): Wood Chip/Waste Bark ABS**

N = 16 personal samples analyzed by ISO (10/10/07 to 10/15/07)

**SL-70366 to SL-70393, SL-70540 to SL-70664 (not sequential): Indoor Worker ABS, Stationary**

N = 75 samples analyzed by ISO (12/10/07 to 1/14/08)

**SL-70404 to SL-70489, SL-70681 to SL-70687 (not sequential): Indoor Worker ABS, Personal**

N = 38 samples analyzed by ISO (11/13/07 to 12/16/07)

**SL-70672 to SL-70677, SL-70702 to SL-70815 (not sequential):**

general worker monitoring during soil sample collection (6/25/08 to 7/14/08)

N = 37 samples analyzed by ISO

\*\*\*ABS programs are shown in blue

**Oct 2002 Contaminant Screening Study (CS-)**

131 field samples (analyzed by PLM-VE)

105 surface, 26 subsurface (mostly 5-pt composites)

Index ID range: CS-08295 to CS-09672

Sample Date range: 10/14/2002 to 10/18/2002

Only 3/131 samples were detect for LA:

|          |    |                               |
|----------|----|-------------------------------|
| CS-09294 | Tr | Southeast Area (0-6")         |
| CS-09595 | Tr | Nursery (0-6")                |
| CS-09658 | <1 | Former Popping Plant (48-60") |

All samples were Vis - (*Note: visible status not in Database*)

**May 2004 Bike Track Sampling (CS-)**

21 field samples (analyzed by PLM-VE)

8 (0-1"), 11 (2-6"), 2 (6-12") (mostly 5-pt composites)

Index ID range: CS-18433 to CS-18498

Sample Date: 5/15/2004

All samples were non-detect for LA

4/21 samples were Vis +

**May 2004 Pre-Design, Central Maintenance Bldg (1D-)**

4 field samples (analyzed by PLM-VE)

4 (0-1" 5-pt composites)

Index ID range: 1D-01823 to 1D-01826

Sample Date: 5/12/2004

All samples were non-detect for LA

2/4 samples were Vis +

**July 2004 Demolition Derby Sampling (CS-)**

19 field samples (analyzed by PLM-VE)

9 (0-1"), 9 (2-6"), 1 (6-12") (5-pt composites)

Index ID range: CS-18581 to CS-18599

Sample Date: 7/1/2004

Only 1/19 samples were detect for LA:

|          |    |               |
|----------|----|---------------|
| CS-18583 | Tr | Grid 2 (0-1") |
|----------|----|---------------|

All samples were Vis - (*Note: visible status not in DB*)

**June 2005 SQAPP ABS (SQ-)**

4 field samples (analyzed by PLM-VE)

4 (0-2") (3-pt to 19-pt composites)

Index ID range: SQ-00061, SQ-00062, SQ-00066, SQ-00067

Sample Dates: 6/21/2005 and 6/25/2005

Only 2/4 samples were detect for LA:

|          |    |                                       |
|----------|----|---------------------------------------|
| SQ-00066 | Tr | Lawn mowing scenario location         |
| SQ-00067 | Tr | Raking & child play scenario location |

Both Trace samples were Vis +

**Oct 2007 Soil Data Gap Study (SL-)**

182 field samples (analyzed by PLM-VE)

180 (0-3" 30-pt composites), 2 (0-12" grabs from beneath piles)

Libby GW Superfund Site, N = 90

Former Nursery Area, N = 11

Waste Bark Piles, N = 2

Libby Creek Banks, N = 21

Stormwater Containment/Waste Water Lagoon, N = 52

Former North Guard Station, N = 1

Diesel Pump House, N = 1

Soil Sample Location CS-09294, N = 4

Index ID range: SL-70001 to SL-70343

Sample Date range: 10/2/2007 to 10/26/2007

7/182 samples were detect for LA:

|          |    |                                  |
|----------|----|----------------------------------|
| SL-70038 | Tr | SCWWL                            |
| SL-70053 | Tr | SCWWL                            |
| SL-70072 | 1  | Former nursery area              |
| SL-70073 | Tr | Former nursery area              |
| SL-70074 | Tr | Former nursery area              |
| SL-70077 | Tr | Former nursery area              |
| SL-70110 | Tr | Libby Groundwater Superfund Site |

*Visible status reported as n-X, n-L, n-M, n-H in DB  
and summarized in CDM report figures*

**June/July 2008 Soil Data Gap Addendum (SL-)**

73 field samples (analyzed by PLM-VE)

73 (0-6" 30-pt composites)

MotoX Track, N = 18

Lumber Yard, N = 16

Southwest Area, N = 16

Railroad Spur, N = 1

Log Storage Area, N = 20

Former Popping Plant, N = 0

Index ID range: SL-70700 to SL-70819

Sample Date range: 6/25/2008 to 7/11/2008

30/73 samples were detect for LA:

Tr: N=29 samples  
<1%: N=1 sample (Former Nursery)

*Visible status reported as n-X, n-L, n-M, n-H in DB*

**Oct 2008 Outdoor ABS (SL-)**

**MotoX ABS**

62 field samples

1 (0-3" 30-pt composites), 30 (0-3" grabs)

1 (0-6" 30-pt composites), 30 (0-6" grabs)

Index ID range: SL-01054 to SL-01387

Sample Date range: 10/16/2008 and 10/21/2008

2/62 analyzed by PLM-VE (composites only)

Both samples were non-detect for LA

*Visible status reported as n-X, n-L, n-M, n-H in DB*

**Worker ABS**

744 field samples [8 areas \* 3 sampling rounds]

24 (0-3" 30-pt composites), 720 (0-3" grabs)

Index ID range: SL-00439 to SL-01633

Sample Date range: 10/7/2008 to 10/24/2008

463/744 analyzed by PLM-VE

10/463 samples were detect for LA:

8 samples: Tr (Former Nursery)

1 sample: <1% (Former Nursery)

1 sample: Tr (SW Area)

*Visible status reported as n-X, n-L, n-M, n-H in DB*

**Oct 2008 Landfarm (SL-)**

51 field samples (analyzed by PLM-VE)

51 subsurface (12-15" grabs)

Index ID range: SL-00900 to SL-00953

Sample Date: 10/14/2008

All samples were non-detect for LA

*Visible status reported as n-X, n-L, n-M, n-H in DB*

**April 2009 Re-Development Sampling (SL-)**

8 field samples (analyzed by PLM-VE)

8 (0-6" 30-pt composites)

Collected from 8 zones

Index ID range: SL-01760 to SL-01767

Sample Date: 4/21/09

All samples were non-detect for LA

All samples were Vis -

**April 2009 Pre-Design Libby Creek Driveway (1D-)**

7 field samples (analyzed by PLM-VE)

7 (0-3" to 0-6" 30-pt composites)

Index ID range: 1D-12501 to 1D-12507

Sample Date: 4/27/2009

All samples were non-detect for LA

All samples were Vis -

**May 2002, Phase 1**

2 field samples (analyzed by TEM-ISO)

collected from former nursery shed

Index IDs: 1-06850 and 1-06857

Sample Date 5/2/2002

1-06850: total LA conc = ND

1-06857: total LA conc = 7,026 s/cm<sup>2</sup>

**Sept 2002 Contaminant Screening Study (SL-)**

37 field samples (analyzed by TEM-ISO)

collected from all site bldgs

Index ID range SL-00059 to SL-00242

Sample Date range 9/12/2002 to 9/18/2002

18/37 samples were detect for LA

Total LA conc detects range: 131 s/cm<sup>2</sup> to 44,116 s/cm<sup>2</sup>

Exceedances of 5,000 s/cm<sup>2</sup>:

|          |        |                                     |
|----------|--------|-------------------------------------|
| SL-00061 | 8,823  | Center of central main. bldg        |
| SL-00175 | 8,823  | Diesel fire pump house              |
| SL-00178 | 44,116 | Guard station at Libby Creek bridge |

**April 2004 Pre-Design, Central Maintenance Bldg (1D-)**

24 field samples (analyzed by TEM-AHERA)

collected from central maintenance bldg

Index ID range 1D-01715 to 1D-01791

Sample Date range 4/19/2004 to 4/30/2004

5/24 samples were detect for LA

Total LA conc detects range: 483 s/cm<sup>2</sup> to 1,449 s/cm<sup>2</sup>

**Nov/Dec 2007 Indoor Worker ABS (SL-)**

24 field samples (analyzed by TEM-ISO)

collected from all ABS bldgs

Index ID range SL-70400 to SL-70497

Sample Date range 11/13/2007 to 12/16/2007

4/24 samples were detect for LA

Total LA conc detects range: 35 s/cm<sup>2</sup> to 185 s/cm<sup>2</sup>

\*\*\*ABS programs are shown in blue

**April 2004 Central Maintenance Bldg PDI (1D-)**

3 field samples (analyzed by PLM NIOSH 9002)

concrete roofing material

Index IDs: 1D-01784, 1D-01787, 1D-01788

Sample Date 4/30/2004

All samples were <1% for TREM-ACT

**Aug 2004 Central Maintenance Bldg PDI (1D-)**

2 field samples (analyzed by PLM NIOSH 9002)

bulk insulation

Index IDs: 1D-01978, 1D-01979

Sample Date 8/12/2004

All samples were non-detect for TREM-ACT

# **Appendix C**

## **Asbestos Analysis Methods and Data Reduction Techniques**

# ASBESTOS ANALYSIS METHODS AND DATA REDUCTION TECHNIQUES

## 1 Asbestos Mineralogy

Asbestos is the generic name for the fibrous habit of a broad family of naturally occurring poly-silicate minerals. Based on crystal structure, asbestos minerals are usually divided into two groups: serpentine and amphibole.

- *Serpentine*: The only asbestos mineral in the serpentine group is chrysotile. Chrysotile is the most widely used form of asbestos, accounting for about 90% of the asbestos used in commercial products (IARC 1977). There is no evidence that chrysotile occurs in the Libby vermiculite deposit, although it may be present in some types of building materials in Libby.
- *Amphiboles*: Five minerals in the amphibole group that occur in the asbestiform habit have found limited use in commercial products (IARC 1977), including:
  - actinolite
  - amosite
  - anthophyllite
  - crocidolite
  - tremolite

At the Libby site, the form of asbestos that is present in the vermiculite deposit is an amphibole asbestos that for many years was classified as tremolite/actinolite (e.g., McDonald et al 1986a, Amandus and Wheeler 1987). More recently, the U.S. Geological Service (USGS) performed electron probe micro-analysis and X-ray diffraction analysis of 30 samples obtained from asbestos veins at the mine (Meeker et al. 2003). Using mineralogical naming rules recommended by Leake et al. (1997), the results indicate that the asbestos at Libby includes a number of related amphibole types. The most common forms are winchite and richterite, with lower levels of tremolite, actinolite, and magnesiorichterite. Because the mineralogical name changes that have occurred over the years do not alter the asbestos material that is present in Libby, and because EPA does not find that there are toxicological data to distinguish differences in toxicity among these different forms, the EPA does not believe that it is important to attempt to distinguish among these various amphibole types. Therefore, EPA simply refers to the mixture as Libby Amphibole (LA) asbestos.

## 2 Measurement Techniques for Asbestos in Air

In the past, the most common technique for measuring asbestos in air was phase contrast microscopy (PCM). In this technique, air is drawn through a filter and airborne particles become deposited on the face of the filter. All structures that have a length greater than 5  $\mu\text{m}$  and have an aspect ratio (the ratio of length to width) of 3:1 or more are counted as PCM fibers. The limit of resolution of PCM is about 0.25  $\mu\text{m}$ , so particles thinner than this are generally not observable.

A key limitation of PCM is that particle discrimination is based only on size and shape. Because of this, it is not possible to classify asbestos particles by mineral type, or even to distinguish between asbestos and non-asbestos particles. For this reason, nearly all samples of air collected in Libby are analyzed by transmission electron microscopy (TEM). This method operates at higher magnification (typically about 20,000x) and hence is able to detect structures much smaller than can be seen by PCM. In addition, TEM instruments are fitted with accessories that allow each particle to be classified according to mineral type.

### **3 Transmission Electron Microscopy (TEM)**

#### **3.1 Sample Preparation**

If air samples were not deemed to be overloaded by particulates<sup>1</sup>, filters are directly prepared for analysis by transmission electron microscopy (TEM) in accord with the preparation methods provided in ISO 10312 (ISO 1995).

If air samples are deemed to be overloaded, samples are prepared indirectly (either with or without ashing as determined by the analyst) in accord with the procedures in SOP EPA-LIBBY-08. In brief, rinsate or ashed residue from the original filter is suspended in water and sonicated. An aliquot of this water is applied to a second filter which is then used to prepare a set of TEM grids. Reported air concentrations for indirectly prepared samples incorporate a dilution factor, or F-factor (see Section 1.3.4 below).

#### **3.2 Sample Analysis**

Air and dust samples collected as part of the OU5 sampling programs were analyzed by TEM in basic accord with the counting and recording rules specified in ISO 10312 (ISO 1995), and the project-specific counting rule modifications specified in the respective SAPs. These modifications included changing the recording rule to include structures with an aspect ratio  $\geq$  3:1.

When a sample is analyzed by TEM, the analyst records the size (length, width) and mineral type of each individual asbestos structure that is observed. Mineral type is determined by Selected Area Electron Diffraction (SAED) and Energy Dispersive Spectroscopy (EDS), and each structure is assigned to one of the following four categories:

**LA**            *Libby-class amphibole.* Structures having an amphibole SAED pattern and an elemental composition similar to the range of fiber types observed in ores from the Libby mine (Meeker et al. 2003). This is a sodic tremolitic solid solution series of minerals including actinolite, tremolite, winchite, and richterite, with lower amounts of magnesio-arfvedsonite and edenite/ferro-edenite.

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<sup>1</sup> Overloaded is defined as >25% obscuration on the majority of the grid openings (see Libby Laboratory Modification #LB-000016 and SOP EPA-LIBBY-08).

- OA**      *Other amphibole-type asbestos fibers.* Structures having an amphibole SAED pattern and an elemental composition that is not similar to fiber types from the Libby mine. Examples include crocidolite, amosite, and anthophyllite. There is presently no evidence that these fibers are associated with the Libby mine.
- C**      *Chrysotile fibers.* Structures having a serpentine SAED pattern and an elemental composition characteristic of chrysotile. There is presently no evidence that these fibers are associated with the Libby mine.
- NAM**      *Non-asbestos material.* These may include non-asbestos mineral fibers such as gypsum, glass, or clay, and may also include various types of organic and synthetic fibers derived from carpets, hair, etc.

For the purposes of this report, air concentrations and dust loading values are based on countable LA structures only (i.e., results for other amphibole-type asbestos and chrysotile are not discussed).

### **3.3 Estimation of PCME**

For the purposes of computing risk estimates, it is necessary to utilize the results from a TEM analysis to estimate what would have been detected had the sample been analyzed by PCM. This is because available toxicity information is usually based on workplace studies that utilized PCM as the primary method for analysis. For convenience, structures detected under TEM that meet the recording rules for PCM (i.e., length > 5  $\mu\text{m}$ , width  $\geq 0.25 \mu\text{m}$ , aspect ratio  $\geq 3:1$ ) are referred to as PCM-equivalent (PCME) structures.

There are two alternative approaches available for expressing units of PCME s/cc. The first (and most direct) approach is to express the concentration of each sample in terms of the PCME structures observed in that sample. The second approach is to express the concentration of LA in each sample in terms of the total LA in that sample, and then multiply the total LA concentration by a value that represents the average fraction of total LA structures that meet PCME counting rules. For this evaluation, the first approach was followed.

In this document, all air concentrations will be reported in units of PCME LA s/cc and all dust loading values will be reported in units of total LA s/cc.

### **3.4 Calculation of Air Concentrations**

The concentration of LA in air is given by:

$$\text{Air Concentration (s/cc)} = N \cdot S$$

where:

N = Number of structures observed

S = Sensitivity ( $\text{cc}^{-1}$ )

For air, the sensitivity is calculated as:

$$S = \frac{EFA}{GO \cdot Ago \cdot V \cdot 1000 \cdot F}$$

where:

- S = Sensitivity for air (cc<sup>-1</sup>)
- EFA = Effective area of the filter (mm<sup>2</sup>)
- GO = Number of grid openings examined
- Ago = Area of a grid opening (mm<sup>2</sup>)
- V = Volume of air passed through the filter (L)
- 1000 = Conversion factor (cc/L)
- F = Fraction of primary filter deposited on secondary filter (indirect preparation only)

### **3.5 Combining Results from Multiple Samples**

When the exposure metric of concern is the average concentration across a set of multiple samples, the best estimate of the mean concentration is calculated simply by averaging the individual concentration values. Note that samples with a count of zero (and hence a air concentration or dust loading of zero) are evaluated as zero when computing the best estimate of the mean (EPA 2008). This approach yields an unbiased estimate of the true mean that does not depend on the analytical sensitivity of the samples included in the data set.

### **3.6 Estimating Confidence Bounds**

*For an Individual Sample*

The uncertainty around a TEM estimate of asbestos concentration in a sample is a function of the number of structures observed during the analysis. The 95% confidence interval around a count of N structures is given by:

$$\begin{aligned} LB &= \frac{1}{2} \cdot \text{CHIINV}[0.025, 2N+1] \\ UB &= \frac{1}{2} \cdot \text{CHIINV}[0.975, 2N+1] \end{aligned}$$

where:

- LB = Lower bound on the 95% confidence interval on N
- UB = Upper bound on the 95% confidence interval on N
- CHIINV = Inverse chi-squared cumulative distribution function
- N = Number of structures observed

As N increases, the absolute width of the confidence interval increases, but the relative uncertainty [expressed as the confidence interval (CI) divided by the observed value (N)] decreases. This is illustrated in the table below.

**Relationship Between Number of Structures  
Observed and Relative Uncertainty**

| Number of Structures Observed (N) | 2.5% Lower Bound N (LB) | 97.5% Upper Bound N (UB) | 95% Confidence Interval Range (CI) [UB-LB] | Relative Uncertainty [CI/N] |
|-----------------------------------|-------------------------|--------------------------|--------------------------------------------|-----------------------------|
| 0                                 | 0.00                    | 2.51                     | 2.51                                       | +Infinity                   |
| 1                                 | 0.11                    | 4.67                     | 4.57                                       | 457%                        |
| 2                                 | 0.42                    | 6.42                     | 6.00                                       | 300%                        |
| 3                                 | 0.84                    | 8.01                     | 7.16                                       | 239%                        |
| 5                                 | 1.91                    | 10.96                    | 9.05                                       | 181%                        |
| 10                                | 5.14                    | 17.74                    | 12.60                                      | 126%                        |
| 20                                | 12.61                   | 30.28                    | 17.67                                      | 88%                         |
| 50                                | 37.54                   | 65.35                    | 27.81                                      | 56%                         |
| 75                                | 59.44                   | 93.46                    | 34.02                                      | 45%                         |
| 100                               | 81.82                   | 121.08                   | 39.26                                      | 39%                         |

2.5% LB =  $0.5 \cdot \text{CHIINV}[0.975, (2 \cdot N+1)]$

97.5% UB =  $0.5 \cdot \text{CHIINV}[0.025, (2 \cdot N+1)]$

Using this approach, the equation for calculation of the upper and lower bounds on the air concentration of asbestos structures is:

$$\text{Air Concentration (s/cc)} = (\text{LB or UB}) \cdot S$$

where:

LB or UB = Number of structures based on lower bound (LB) or upper bound (UB)

S = Sensitivity ( $\text{cc}^{-1}$  for air)

#### *Across Multiple Samples*

Calculation of the uncertainty bounds around the average of a group of asbestos samples is complicated by the fact that the between-sample variability in the measured concentration values includes the between-sample variability that arises from both analytical measurement error in individual samples and from between-sample temporal or spatial variability. EPA has not yet developed a method for calculating uncertainty bounds around the mean of asbestos

data sets, so no uncertainty bounds are provided in this report for mean values (EPA 2008). However, it is important to recognize that the values are uncertain, and that actual values might be either higher or lower than reported.

## **4 Polarized Light Microscopy Analysis (PLM)**

### **4.1 Sample Preparation**

Soil samples collected as part of the OU5 sampling programs were prepared for analysis in accord with SOP ISSI-LIBBY-01 as specified in the CDM Close Support Facility (CSF) Soil Preparation Plan (SPP) (CDM 2004). In brief, each soil sample is dried and sieved through a ¼ inch screen. Particles retained on the screen (if any) are referred to as the “coarse” fraction. Particles passing through the screen are referred to as the fine fraction, and this fraction is ground by passing it through a plate grinder. The resulting material is referred to as the “fine ground” fraction. The fine ground fraction is split into four equal aliquots; one aliquot is submitted for analysis and the remaining aliquots are archived at the CSF.

### **4.2 Sample Analysis**

Soil samples collected at the Libby Site are analyzed using polarized light microscopy (PLM). The coarse fractions were examined using stereomicroscopy, and any particles of asbestos (confirmed by PLM) were removed and weighed in accord with SRC-LIBBY-01 (referred to as “PLM-Grav”). The fine ground aliquots were analyzed using a Libby-specific PLM method using visual area estimation, as detailed in SOP SRC-LIBBY-03. For convenience, this method is referred to as “PLM-VE”.

PLM-VE is a semi-quantitative method that utilizes site-specific LA reference materials to allow assignment of fine ground samples into one of four “bins”, as follows:

- *Bin A (ND)*: non-detect
- *Bin B1 (Trace)*: detected at levels lower than the 0.2% LA reference material
- *Bin B2 (<1%)*: detected at levels lower than the 1% LA reference material but higher than the 0.2% LA reference material
- *Bin C*: LA detected at levels greater than or equal to the 1% LA reference material

Of the 985 soil field samples collected during these OU5 sampling programs, 739 samples had a coarse fraction, and all but one<sup>2</sup> of these samples was reported as non-detect for LA when analyzed by PLM-Grav. In this case, the PLM-VE result was “<1”. Because of this, this report focuses on the PLM-VE results for the fine ground fraction only.

## **5 Soil Visual Inspection**

At the time of soil sample collection for PLM analysis, the sampling team performed a visual inspection of the displaced soil at each sampling point to determine if visible vermiculite was

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<sup>2</sup> PLM-Grav result for this sample was reported as “Tr”.

present in accord with SOP CDM-LIBBY-06. A semi-quantitative estimate (none, low, moderate<sup>3</sup>, high) of the amount of visible vermiculite present was noted for each sampling point. For composite samples, a count of the number of sampling points assigned to each visible vermiculite ranking was recorded on the Field Sample Data Sheet (FSDS) in the sample comments (e.g., 18 none [X], 6 low [L], 4 moderate [M], 2 high [H]).

There are several alternative ways that this visual inspection data can be used to characterize the level of vermiculite contamination (and presumptive LA contamination) in an area.

#### Option 1: Present/Absent

The simplest strategy classifies an area either as “Vis –” if all sampling points in the composite were assigned a value of “none”, or as “Vis +” if one or more of the sampling points were assigned a value of “low”, “moderate”, or “high”.

A potential limitation to this ranking strategy is that it does not account for differences in the amount or frequency of visible vermiculite detections. For example, an area with 1 “low” point and 29 “none” points and an area with 24 “moderate” points and 5 “high” points would both be ranked as “Vis +”.

#### Option 2: Detection Frequency

In this approach, an area is assigned a value equal to the detection frequency by visible inspection. For example, an area with 1 “low” point and 29 “none” points would receive a value of 1/30 (3.3%), while an area with 24 “moderate” points and 5 “high” points would receive a score of 29/30 ( 97%).

While this approach does account for the frequency of visible vermiculite, it does not consider the amount vermiculite observed. In other words, an ABS area with 5 “low” points and 25 “none” points would have the same detection frequency of 5/30 (17%) as an ABS area with 5 “high” points and 25 “none” points.

#### Option 3: Amount-Weighted Score

In this approach, both the frequency and the level of vermiculite are considered. This is achieved by assigning a weighting factor to each level, where the weighting factors are intended to represent the relative levels of vermiculite in each category. As presented in SOP CDM-LIBBY-06, the guidelines for assigning levels are as follows:

|        |                                                                                |
|--------|--------------------------------------------------------------------------------|
| None = | No flakes of vermiculite detected observed within the inspection point.        |
| Low =  | A maximum of a few flakes of vermiculite observed within the inspection point. |

---

<sup>3</sup> The visual inspection SOP CDM-LIBBY-06 uses the terminology “intermediate” to refer to the “moderate” classification. For the purposes of this document, the term “moderate” is retained to correspond with the accompanying field documentation.

Moderate/High = Vermiculite easily observed throughout the inspection point, including the surface. A ranking of High is reserved for samples that are 50% or more vermiculite. Others (<50%) are assigned a ranking of Moderate.

Based on these descriptions, the weighting factors that were used to calculate scores are as follows:

| Visible Vermiculite Level ( $L_i$ ) | Weighting factor ( $W_i$ ) |
|-------------------------------------|----------------------------|
| None                                | 0                          |
| Low                                 | 1                          |
| Moderate                            | 3                          |
| High                                | 10                         |

The score is then the weighted sum of the observations for the area:

$$Score = \frac{\sum_{i=1}^x L_i \cdot W_i}{x}$$

This value can range from zero (all points are “none”) to a maximum of 10 (all points are “high”). For example, an area with 1 “low” point and 29 “none” points would receive a value of  $1/30 = 0.033$ , while an area with 24 “moderate” points and 5 “high” would receive a score of  $(24 \cdot 3 + 5 \cdot 10) / 30 = 4.13$ .

# **Appendix D**

## **Analytical and Other Data**

# **Appendix D1**

## **Scribe Database**

Scribe database is available on CD by request.

Contact the EPA Records Center to request a copy: 303-312-6473.

## **Appendix D2**

### **Scribe Queries**

## SRC Air Results Queries for OU5 Scribe

### SRC\_Air Total LA Concentration Data

#### Purpose:

The purpose is to select binned air analytical results for field samples that have been analyzed by TEM. Results for LA particles from analyses that are not lab QC are selected.

#### SQL Code:

```
SELECT Samples.Samp_No, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Samples.SampleType, Samples.Remarks,
Analysis.AnalysisMethod, Analysis.AnalysisDate, Analysis.AnalysisLabID, Analysis.AnalysisPrepMethod,
Analysis.AnalysisLabSampleID, Analysis.AnalysisLabJobNumber, Analysis.AnalysisFilterStatus,
Analysis.AnalysisGOSize, Analysis.AnalysisGOCounted, Analysis.AnalysisEFA,
Analysis.AnalysisFFactor, Analysis.AnalysisQuantityAnalyzed, Analysis.AnalysisQuantityAnalyzedUnits,
Analysis.AnalysisLabQCType, LabResults.Result, LabResults.Result_Qualifier,
LabResults.Lab_Result_Qualifier, LabResults.Result_Units, LabResults.Comments,
LabResults.CharacteristicID, LabResults.ResultMineralClass
FROM (LabResults INNER JOIN Analysis ON LabResults.AnalysisID = Analysis.AnalysisID) INNER JOIN
Samples ON Analysis.Samp_No = Samples.Samp_No
WHERE (((Samples.Matrix)="air") AND ((Samples.SampleType)="field sample") AND
((Analysis.AnalysisFilterStatus)="analyzed") AND ((Analysis.AnalysisLabQCType)="not qa") AND
((LabResults.ResultMineralClass)="la"));
SRC_Soil Results_PLM9002_Part1
```

### SRC\_Air Concentration Data\_Raw Struc\_Part1

#### Purpose:

The purpose is to select raw structure data for air samples that have been analyzed by TEM.

#### SQL Code:

```
SELECT Samples.Samp_No, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Samples.SampleType, Samples.Remarks,
Analysis.AnalysisMethod, Analysis.AnalysisDate, Analysis.AnalysisLabID, Analysis.AnalysisPrepMethod,
Analysis.AnalysisLabSampleID, Analysis.AnalysisLabJobNumber, Analysis.AnalysisFilterStatus,
Analysis.AnalysisGOSize, Analysis.AnalysisGOCounted, Analysis.AnalysisEFA,
Analysis.AnalysisFFactor, Analysis.AnalysisQuantityAnalyzed, Analysis.AnalysisQuantityAnalyzedUnits,
Analysis.AnalysisLabQCType, Structures.Grid, Structures.GridOpening, Structures.StructureType,
Structures.Primary, Structures.Total, Structures.Length, Structures.Width, Structures.MineralClass,
[Length]/[Width] AS AR, Structures.StructureIdentification
FROM (Analysis INNER JOIN Samples ON Analysis.Samp_No = Samples.Samp_No) INNER JOIN
Structures ON Analysis.AnalysisID = Structures.AnalysisID
WHERE (((Samples.Matrix)="air") AND ((Analysis.AnalysisFilterStatus)="analyzed"));
```

### SRC\_Air Concentration Data\_Raw Struc\_Part2

#### Purpose:

This query is a continuation of "SRC\_Air Concentration Data\_Raw Struc\_Part1".

The purpose is to select LA raw structure data for field samples that are not lab QC analyses.

#### SQL Code:

```
SELECT [SRC_Air Concentration Data_Raw Struc_Part1].Samp_No, [SRC_Air Concentration Data_Raw
Struc_Part1].SampleDate, [SRC_Air Concentration Data_Raw Struc_Part1].Location, [SRC_Air
Concentration Data_Raw Struc_Part1].Sub_Location, [SRC_Air Concentration Data_Raw
Struc_Part1].Matrix, [SRC_Air Concentration Data_Raw Struc_Part1].Sub_Matrix, [SRC_Air
Concentration Data_Raw Struc_Part1].SampleType, [SRC_Air Concentration Data_Raw
Struc_Part1].Remarks, [SRC_Air Concentration Data_Raw Struc_Part1].AnalysisMethod, [SRC_Air
Concentration Data_Raw Struc_Part1].AnalysisDate, [SRC_Air Concentration Data_Raw
Struc_Part1].AnalysisLabID, [SRC_Air Concentration Data_Raw Struc_Part1].AnalysisPrepMethod,
```

```

[SRC_Air Concentration Data_Raw Struc_Part1].AnalysisLabSampleID, [SRC_Air Concentration
Data_Raw Struc_Part1].AnalysisLabJobNumber, [SRC_Air Concentration Data_Raw
Struc_Part1].AnalysisFilterStatus, [SRC_Air Concentration Data_Raw Struc_Part1].AnalysisGOSize,
[SRC_Air Concentration Data_Raw Struc_Part1].AnalysisGOCounted, [SRC_Air Concentration
Data_Raw Struc_Part1].AnalysisEFA, [SRC_Air Concentration Data_Raw Struc_Part1].AnalysisFFactor,
[SRC_Air Concentration Data_Raw Struc_Part1].AnalysisQuantityAnalyzed, [SRC_Air Concentration
Data_Raw Struc_Part1].AnalysisQuantityAnalyzedUnits, [SRC_Air Concentration Data_Raw
Struc_Part1].AnalysisLabQCType, [SRC_Air Concentration Data_Raw Struc_Part1].Grid, [SRC_Air
Concentration Data_Raw Struc_Part1].GridOpening, [SRC_Air Concentration Data_Raw
Struc_Part1].StructureType, [SRC_Air Concentration Data_Raw Struc_Part1].Primary, [SRC_Air
Concentration Data_Raw Struc_Part1].Total, [SRC_Air Concentration Data_Raw Struc_Part1].Length,
[SRC_Air Concentration Data_Raw Struc_Part1].Width, [SRC_Air Concentration Data_Raw
Struc_Part1].AR, [SRC_Air Concentration Data_Raw Struc_Part1].MineralClass, [SRC_Air Concentration
Data_Raw Struc_Part1].StructureIdentification, If([Length]>5 And [Width]>=0.25 And [AR]>=3 And
[MineralClass] Like "LA" And [Total]>0,1,0) AS PCMEIa, If([Length]>10 And [AR]>=3 And [MineralClass]
Like "LA" And [Total]>0,1,0) AS BCla
FROM [SRC_Air Concentration Data_Raw Struc_Part1]
WHERE ((([SRC_Air Concentration Data_Raw Struc_Part1].Matrix)="air") AND (([SRC_Air Concentration
Data_Raw Struc_Part1].SampleType)="field sample") AND (([SRC_Air Concentration Data_Raw
Struc_Part1].AnalysisFilterStatus)="analyzed") AND (([SRC_Air Concentration Data_Raw
Struc_Part1].AnalysisLabQCType)="not qa"));

```

## SRC Soil Results Queries for OU5 Scribe

### **SRC\_Soil PLMVE Min Analysis Date**

#### Purpose:

Select the first analysis performed for a sample. This is the true "NOT QA". For PLM-VE subsequent analyses have been performed on samples and the database does not correctly identify these. The main reason for this is that the laboratories do not know that they are performing a QC analysis and therefore do not identify them as such. This has been recognized as a problem, but the only solution to it is to change the database after the fact and this has not happened yet and it is uncertain if this ever will happen.

#### SQL Code:

```
SELECT Analysis.Samp_No, Analysis.AnalysisMethod, Min(Analysis.AnalysisDate) AS  
MinOfAnalysisDate  
FROM Analysis  
GROUP BY Analysis.Samp_No, Analysis.AnalysisMethod  
HAVING (((Analysis.AnalysisMethod)="PLM-VE"));
```

### **SRC\_Soil Results\_PLM9002\_Part1**

#### Purpose:

List all soil samples analyzed by PLM-9002.

#### SQL Code:

```
SELECT Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum,  
Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location,  
Samples.Matrix, Samples.Sub_Matrix, Min(Analysis.AnalysisDate) AS MinOfAnalysisDate,  
Analysis.AnalysisLabQCType, LabResults.CharacteristicID, LabResults.Result,  
LabResults.Result_Qualifier, LabResults.Result_Units,  
If([LabResults].[Result_Qualifier]="ND","ND",If([LabResults].[Result_Qualifier]="Tr","TR",If([LabResults].[  
Result_Qualifier]="<","<1",[LabResults].[Result]))) AS [9002 Result (%)], LabResults.ResultMineralClass  
FROM Location INNER JOIN ((LabResults INNER JOIN Analysis ON LabResults.AnalysisID =  
Analysis.AnalysisID) INNER JOIN Samples ON Analysis.Samp_No = Samples.Samp_No) ON  
Location.Location = Samples.Location  
GROUP BY Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum,  
Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location,  
Samples.Matrix, Samples.Sub_Matrix, Analysis.AnalysisLabQCType, LabResults.CharacteristicID,  
LabResults.Result, LabResults.Result_Qualifier, LabResults.Result_Units,  
If([LabResults].[Result_Qualifier]="ND","ND",If([LabResults].[Result_Qualifier]="Tr","TR",If([LabResults].[  
Result_Qualifier]="<","<1",[LabResults].[Result]))) AS [9002 Result (%)], LabResults.ResultMineralClass,  
LabResults.Analytical_Method  
HAVING (((Samples.SampleType)="field sample") AND ((Samples.Matrix)="soil") AND  
((Samples.Sub_Matrix) Like "*soil*") AND ((Analysis.AnalysisLabQCType)="not qa") AND  
((LabResults.Analytical_Method)="PLM-9002"));
```

### **SRC\_Soil Results\_PLM9002\_Part2**

#### Purpose:

Transpose soil data\_PLM-9002\_part1.

#### SQL Code:

```
TRANSFORM Max([SRC_Soil Results_PLM9002_Part1].[9002 Result (%)]) AS [MaxOf9002 Result (%)]  
SELECT [SRC_Soil Results_PLM9002_Part1].Samp_No, [SRC_Soil Results_PLM9002_Part1].Latitude,  
[SRC_Soil Results_PLM9002_Part1].Longitude, [SRC_Soil Results_PLM9002_Part1].Datum, [SRC_Soil  
Results_PLM9002_Part1].SampleType, [SRC_Soil Results_PLM9002_Part1].SampleDate, [SRC_Soil  
Results_PLM9002_Part1].Location, [SRC_Soil Results_PLM9002_Part1].Sub_Location, [SRC_Soil  
Results_PLM9002_Part1].Matrix, [SRC_Soil Results_PLM9002_Part1].Sub_Matrix, [SRC_Soil  
Results_PLM9002_Part1].MinOfAnalysisDate, [SRC_Soil Results_PLM9002_Part1].AnalysisLabQCType  
FROM [SRC_Soil Results_PLM9002_Part1]
```

GROUP BY [SRC\_Soil Results\_PLM9002\_Part1].Samp\_No, [SRC\_Soil Results\_PLM9002\_Part1].Latitude, [SRC\_Soil Results\_PLM9002\_Part1].Longitude, [SRC\_Soil Results\_PLM9002\_Part1].Datum, [SRC\_Soil Results\_PLM9002\_Part1].SampleType, [SRC\_Soil Results\_PLM9002\_Part1].SampleDate, [SRC\_Soil Results\_PLM9002\_Part1].Location, [SRC\_Soil Results\_PLM9002\_Part1].Sub\_Location, [SRC\_Soil Results\_PLM9002\_Part1].Matrix, [SRC\_Soil Results\_PLM9002\_Part1].Sub\_Matrix, [SRC\_Soil Results\_PLM9002\_Part1].MinOfAnalysisDate, [SRC\_Soil Results\_PLM9002\_Part1].AnalysisLabQCType  
 PIVOT [SRC\_Soil Results\_PLM9002\_Part1].CharacteristicID;

### **SRC\_Soil Results\_PLMGrav**

#### Purpose:

List results for soil samples analyzed by PLM-Grav. The result is the ResultsQualifier ; this is populated in a new column titled "GRAV RESULT (%)".

#### SQL Code:

```
SELECT Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum,
Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Min(Analysis.AnalysisDate) AS MinOfAnalysisDate,
Analysis.AnalysisLabQCType,
If([LabResults]![Result_Qualifier]="ND","ND",If([LabResults]![Result_Qualifier]="Tr","TR",If([LabResults]!
[Result_Qualifier]="<","<1",[LabResults]![Result]))) AS [GRAV Result (%)]
FROM Location INNER JOIN ((LabResults INNER JOIN Analysis ON LabResults.AnalysisID =
Analysis.AnalysisID) INNER JOIN Samples ON Analysis.Samp_No = Samples.Samp_No) ON
Location.Location = Samples.Location
GROUP BY Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum,
Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Analysis.AnalysisLabQCType,
If([LabResults]![Result_Qualifier]="ND","ND",If([LabResults]![Result_Qualifier]="Tr","TR",If([LabResults]!
[Result_Qualifier]="<","<1",[LabResults]![Result]))), LabResults.ResultMineralClass,
LabResults.Analytical_Method
HAVING (((Samples.SampleType)="field sample") AND ((Samples.Matrix)="soil") AND
((Samples.Sub_Matrix) Like "*soil*") AND ((Analysis.AnalysisLabQCType)="not qa") AND
((LabResults.ResultMineralClass)="la") AND ((LabResults.Analytical_Method) Like "*grav*"));
```

### **SRC\_Soil Results\_PLMVE**

#### Purpose:

List results for soil samples analyzed by PLM-VE. The result is the ResultsQualifier ; this is populated in a new column titled "VE MF RESULT (%)".

#### SQL Code:

```
SELECT Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum,
Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Min(Analysis.AnalysisDate) AS MinOfAnalysisDate,
Analysis.AnalysisLabQCType,
If([LabResults]![Result_Qualifier]="ND","ND",If([LabResults]![Result_Qualifier]="Tr","TR",If([LabResults]!
[Result_Qualifier]="<","<1",[LabResults]![Result]))) AS [VE MF Result (%)]
FROM [SRC_Soil PLMVE Min Analysis Date] INNER JOIN (Location INNER JOIN ((LabResults INNER
JOIN Analysis ON LabResults.AnalysisID=Analysis.AnalysisID) INNER JOIN Samples ON
Analysis.Samp_No=Samples.Samp_No) ON Location.Location=Samples.Location) ON ([SRC_Soil
PLMVE Min Analysis Date].Samp_No=Analysis.Samp_No) AND ([SRC_Soil PLMVE Min Analysis
Date].MinOfAnalysisDate=Analysis.AnalysisDate)
GROUP BY Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum,
Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Analysis.AnalysisLabQCType,
If([LabResults]![Result_Qualifier]="ND","ND",If([LabResults]![Result_Qualifier]="Tr","TR",If([LabResults]!
```

```
[Result_Qualifier]="<","<1",[LabResults].[Result]])), LabResults.ResultMineralClass,
LabResults.CharacteristicID, LabResults.Analytical_Method
HAVING (((Samples.SampleType)="field sample") AND ((Samples.Matrix)="soil") AND
((Samples.Sub_Matrix) Like "*soil*") AND ((Analysis.AnalysisLabQCType)="not qa") AND
((LabResults.ResultMineralClass)="la") AND ((LabResults.CharacteristicID)="mfla") AND
((LabResults.Analytical_Method) Like "*ve*"));
```

### **SRC\_Soil Results\_ALL**

#### Purpose:

Combine results for all methods available for each sample.

#### SQL Code:

```
SELECT Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum,
Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Min(Analysis.AnalysisDate) AS MinOfAnalysisDate1,
Analysis.AnalysisLabQCType, [SRC_Soil Results_PLM9002_Part2].[TREM-ACTN] AS [9002 TREM-
ACTN (%)], [SRC_Soil Results_PLMGrav].[GRAV Result (%)], [SRC_Soil Results_PLMVE].[VE MF
Result (%)], Samples.Remarks
FROM ([SRC_Soil Results_PLMGrav] RIGHT JOIN ((Location INNER JOIN (Analysis INNER JOIN
Samples ON Analysis.Samp_No = Samples.Samp_No) ON Location.Location = Samples.Location) LEFT
JOIN [SRC_Soil Results_PLMVE] ON Analysis.Samp_No = [SRC_Soil Results_PLMVE].Samp_No) ON
[SRC_Soil Results_PLMGrav].Samp_No = Analysis.Samp_No) LEFT JOIN [SRC_Soil
Results_PLM9002_Part2] ON Analysis.Samp_No = [SRC_Soil Results_PLM9002_Part2].Samp_No
GROUP BY Samples.Samp_No, Location.Latitude, Location.Longitude, Location.Datum,
Samples.SampleType, Samples.SampleDate, Samples.Location, Samples.Sub_Location,
Samples.Matrix, Samples.Sub_Matrix, Analysis.AnalysisLabQCType, [SRC_Soil
Results_PLM9002_Part2].[TREM-ACTN], [SRC_Soil Results_PLMGrav].[GRAV Result (%)], [SRC_Soil
Results_PLMVE].[VE MF Result (%)], Samples.Remarks
HAVING (((Samples.SampleType)="field sample") AND ((Samples.Matrix)="soil") AND
((Samples.Sub_Matrix) Like "*soil*") AND ((Analysis.AnalysisLabQCType)="not qa"));
```

# **Appendix E**

## **Data Quality Assessment**

## **Appendix E**

### **Data Quality Assessment**

|     |                                              |    |
|-----|----------------------------------------------|----|
| 1   | Audits.....                                  | 1  |
| 1.1 | Field Audits.....                            | 1  |
| 1.2 | Laboratory Audits.....                       | 2  |
| 2   | Modifications.....                           | 2  |
| 3   | Data Verification.....                       | 2  |
| 4   | Quality Control Sample Summary .....         | 3  |
| 4.1 | Field QC Samples.....                        | 4  |
| 4.2 | Soil Preparation Laboratory QC Samples ..... | 6  |
| 4.3 | QC Conclusions.....                          | 9  |
| 5   | Data Adequacy Evaluation.....                | 9  |
| 5.1 | Moto-X Park ABS Samples.....                 | 9  |
| 5.2 | Recreational Visitor ABS Samples .....       | 10 |
| 5.3 | Indoor Worker ABS Samples .....              | 11 |
| 5.4 | Outdoor Worker ABS Samples .....             | 13 |
| 6   | DQA Conclusions.....                         | 16 |

---

Data quality assessment (DQA) is the process of reviewing existing data to establish the quality of the data and to determine how any data quality limitations may influence data interpretation (EPA 2006).

For the purposes of the risk assessment, the principle datasets utilized to quantify potential exposures are the air samples collected during the various activity-based sampling (ABS) programs at the OU5 Site. In addition, soil data (both visible vermiculite inspection results and polarized light microscopy visual area estimation [PLM-VE] results) are utilized in the interpretation of the outdoor worker ABS results. Therefore, this DQA focuses on the ABS air samples and the site-wide soil samples used to support the OU5 risk assessment.

## **1 Audits**

### **1.1 Field Audits**

Field audits are conducted to evaluate field personnel in their day-to-day activities and ensure all processes and procedures are performed in accord with the applicable field guidance documents (or approved Libby Field Office [LFO] modification forms) to make certain that samples collected are correct and consistent. All aspects of data documentation and sample collection, as well as sample handling, custody, and shipping are evaluated. If any issues are identified, field personnel are notified and retrained as appropriate.

A field audit was performed on September 17, 2008, to evaluate field procedures for air samples collected as part of the MotoX Park and Recreational Visitor ABS programs. The auditor concluded that the field personnel were very effective and efficient at implementing sampling and reporting ABS program requirements and commended the field personnel and staff for their

efforts in maintaining an effective field program and their persistent focus on detail and quality (Updike 2009).

## **1.2 Laboratory Audits**

Laboratory audits are conducted to evaluate laboratory personnel to ensure that samples are handled and analyzed in accord with the program-specific documents and analytical method requirements (or approved Libby laboratory modification forms) to make certain that analytical results reported are correct and consistent. All aspects of sample handling, preparation, and analysis are evaluated. If any issues are identified, laboratory personnel are notified and retrained as appropriate.

A series of laboratory audits was performed in the Summer/Fall of 2008 to evaluate all of the Libby laboratories. No critical deficiencies were noted during the laboratory audits that would be expected to impact data quality.

## **2 Modifications**

During any large-scale sampling program, such as the OU5 ABS programs, deviations from the original Sampling and Analysis Plan (SAP) may occur and/or it may be necessary to modify procedures identified in the original SAP to optimize sample collection and analysis. At the Libby Site, all field and laboratory modifications are recorded in site-specific modification forms. These forms provide a standardized format for tracking procedural changes in sample collection and analysis and allow project managers to assess potential impacts on the quality of the data being collected.

During the OU5 programs, a number of field and laboratory modifications were created that document changes in sample collection and analysis methodology specified in the original SAPs. Table E-1 summarizes the modifications that are applicable to the various programs at the OU5 Site, and notes the impact of each on the quality and usability of the data. As indicated, most of the modifications are not expected to have an impact on data quality or usability. Modifications which may have influenced the achieved analytical sensitivities could have potential impacts on data quality and interpretation. These potential impacts are discussed in more detail in Section 1.5, the data adequacy evaluation.

## **3 Data Verification**

The Libby Site project database has a number of built-in quality control checks to identify unexpected or unallowable data values during the upload of any new data into the database. Any issues identified by these automatic upload checks were resolved by consultation with the field teams and/or analytical laboratories before entry of the data into the database. After entry of the data into the database, several additional data verification steps were taken to ensure the data were recorded and entered correctly.

In order to ensure that the database accurately reflects the original hard copy documentation, all data downloaded from the database were examined to identify data omissions, unexpected

values, or apparent inconsistencies. In addition, 10% of all samples and analytical results underwent a detailed verification. In brief, verification involves comparing the data for a sample in the database to information on the original hard copy field sample data sheet (FSDS) form and on the original hard copy analytical bench sheets for that sample. Any omissions or apparent errors identified during the verification were submitted to the field teams and/or analytical laboratories for resolution and rectification in the project database and in the hard copy documentation.

FSDS Review. Hard copy FSDS forms were reviewed for a total of 42 ABS air samples as part of the data verification effort. While a few minor typographical errors were noted, no critical errors (i.e., errors that would influence the quantitative analytical results reported for the sample) were identified during this verification effort.

TEM Review. A total of 42 transmission electron microscopy (TEM) analyses were reviewed as part of the data verification effort. Attachment 1 presents a summary of the findings of the TEM data verification for the OU5 Site. In general, the majority of issues identified were due to the incorrect transfer of data from the hard copy report to the EDD (e.g., structure lengths were rounded, photo reference numbers were incorrect). However, it is important to note that none of the errors identified were critical in nature (i.e., critical errors are those that would influence the quantitative results).

PLM Review. A total of 108 PLM analyses were reviewed as part of the data verification effort. Attachment 2 presents a summary of the findings of the PLM data verification for the OU5 Site. The data verification identified critical errors in the reported PLM-VE bin for two soil samples (error rate of ~2%). Results for these samples have been corrected. There were also several findings that involve the incorrect transfer of data from the hard copy report to the EDD; however, none of these errors were critical in nature. While the critical error rate was low, future data verification of additional PLM results may be warranted.

All issues identified during the data verification effort were submitted to the field teams and/or analytical laboratories for resolution and rectification. All tables, figures, and appendices generated for this report reflect corrected data.

#### **4 Quality Control Sample Summary**

A number of Quality Control (QC) samples were collected as part of the ABS programs to help characterize the accuracy and precision of the data obtained. QC samples included both field-based samples (which are submitted blind to the laboratories) and laboratory-based samples.

## **4.1 Field QC Samples**

### **4.1.1 Air and Dust**

#### ***Lot Blanks***

A lot blank is a filter cassette which has been taken from a new box of filter cassettes. Lot blanks are collected to ensure that sample filter cassettes do not have any asbestos contamination prior to their use in the field. If any asbestos structures are observed on the lot blank during the TEM analysis, the entire box of filter cassettes associated with that lot is discarded.

In accord with the OU5 ABS SAPs, one lot blank was submitted for every 500 air filter cassettes and every 300 dust filter cassettes. A total of 14 lot blanks were analyzed during the time of the OU5 ABS programs (i.e., October 2007 to October 2008). No asbestos structures were observed in any lot blank sample. Based on these results, it is concluded that air and dust filter cassettes utilized during the various OU5 ABS programs did not have asbestos contamination.

#### ***Field Blanks***

A field blank is a filter cassette that is taken to the field and opened, but through which no air is drawn. Field blank samples for air are prepared for TEM analysis using a direct preparation, while field blank samples for dust are prepared using an indirect preparation.

In accord with the OU5 ABS SAPs, field blanks for air and dust were collected at a rate of one per property per day. Approximately 10% of the total field blanks collected per week were analyzed by TEM. The field blanks selected for analysis ranged across the duration of the OU5 ABS programs.

A total of 22 air field blanks and 8 dust field blanks were collected during the time of the OU5 ABS programs (i.e., October 2007 to October 2008) and analyzed by TEM. No asbestos structures were observed in any of the analyzed field blank samples. This demonstrates that filter contamination due from either field or laboratory sources is not expected to influence asbestos results for samples collected as part of the OU5 ABS programs.

#### ***Field Duplicates/Replicates***

A field duplicate or replicate is a second sample of air or dust which is collected at the same time and location as the original field sample. These samples are collected independent of the original field sample with separate sampling equipment. Field duplicates or replicates help to evaluate the inherent variability of sample results due to small-scale variability in concentration as well as variability in sample analysis.

A total of 3 air field replicates and 2 dust field duplicates were collected as part of the OU5 ABS programs. Table E-2 summarizes the detailed TEM results for all field duplicate/replicate samples collected. The total Libby amphibole (LA) asbestos concentration estimates derived

from the original and duplicate/replicate samples are compared using the method for comparison of two Poisson rates described by Nelson (1982). As seen, in most cases, both the original and the duplicate/replicate results were non-detect (i.e., not statistically different from each other). For the one dust sample where LA structures were observed, the difference between the original and the dust duplicate results were not statistically different. Based on this, it is concluded that air and dust sample results are reproducible, at least within the target analytical sensitivity.

#### 4.1.2 Soil

##### **Field Duplicates**

A field duplicate for soil is an independent sample of soil collected at the same place and at the same time as the primary sample. Field duplicates for soil were collected at a rate of about 1 field duplicate per 20 field samples in accordance with the frequencies specified in the Outdoor Worker ABS SAP (EPA 2008b), resulting in 37 field duplicates (out of 744 field samples).

Field duplicate results analyzed by PLM are ranked as concordant if both the original sample result and the field duplicate result report the same semi-quantitative bin classification. Results are ranked as weakly discordant if the original sample result and the field duplicate result differed by one semi-quantitative bin classification (e.g., Bin A vs. Bin B1). Results are ranked as strongly discordant if the original sample result and the field duplicate result differed by more than one semi-quantitative bin classification (e.g., Bin A vs. Bin B2). Results are evaluated based on the frequency of strongly discordant results, using the criteria contained in the table below.

| <b>Metric</b>                            | <b>Good</b> | <b>Acceptable</b> | <b>Poor</b> |
|------------------------------------------|-------------|-------------------|-------------|
| % of pairs ranked as strongly discordant | <5%         | 5-10%             | >10%        |

Table E-3 summarizes the results of the original and field duplicate samples for soil. As seen, most samples (35 out of 37) were ranked as non-detect in both the original sample result and the field duplicate result. For the two sample pairs that were ranked as discordant, the results were only weakly discordant. This discordance may be due to analytical variability, but might also arise from authentic heterogeneity between the soil samples. No sample pairs were ranked as strongly discordant.

These results support the conclusion that estimates of soil concentration by PLM are generally reproducible, and are not greatly influenced by potential differences in field collection methods, small-scale spatial variability, or laboratory preparation and analysis techniques.

## **4.2 Soil Preparation Laboratory QC Samples**

### **4.2.1 Preparation Blanks**

A preparation blank consists of asbestos-free quartz sand which is processed with each batch of soil samples. A batch of samples is defined as a group of samples that have been prepared together for analysis at the same time. Preparation blanks determine if cross-contamination is occurring during sample preparation processing (i.e., drying, sieving, grinding, and splitting).

A total of 119 preparation blanks were analyzed by PLM-VE during the time of the OU5 ABS programs. No asbestos was detected in any blank sample. Based on these results, it is concluded that preparation methods at the soil preparation laboratory were unlikely to introduce LA contamination that would result in a quantifiable impact on soil results analyzed by PLM-VE.

### **4.2.2 Preparation Splits**

Preparation splits are splits of field samples submitted for soil sample preparation. After drying but prior to sieving, the original field sample is split into two equal aliquots using the Jones splitter. One preparation split is included for every 20 field samples prepared. Comparison of the results for preparation split with the paired original field samples helps to evaluate the variability that arises during the preparation and analysis steps. Concordance between the preparation split analysis and the original analysis is evaluated using a methodology similar to that described above for field duplicates.

Table E-4 summarizes the PLM-VE results of the original and preparation split samples for soil. As seen, all samples (42 out of 42) were ranked as non-detect (Bin A) in both the original sample result and the preparation split result. These results support the conclusion that the soil sample results are generally reproducible and reliable and are not greatly influenced by differences in laboratory preparation and analysis techniques.

### **4.2.3 Performance Evaluation Samples**

A performance evaluation (PE) sample is a soil sample with a known level of LA that is provided blind to the laboratories for the purposes of evaluating analytical accuracy. PE samples of LA were created as part of the PE Study (EPA 2000; 2003a,b) by spiking uncontaminated soil from Libby with a known amount of asbestos material derived from the mine in Libby. PE samples are inserted into the soil sample train by the soil preparation laboratory at the time of sample preparation.

To date, a total of 34 PE samples have been submitted to the PLM-VE analytical laboratories for analysis. In order to avoid “unblinding” the nominal levels in the PE samples to the analytical laboratories, detailed results tables are not presented in this report. In general, the PLM-VE results provided by the analytical laboratory for all PE samples were fairly consistent with the expected result based on the nominal level. When results were discordant, the laboratories tended to overestimate LA levels in soil compared to nominal levels. These results support the conclusion that the PLM-VE results generally tend to be accurate and reliable.

### **4.3 Analytical Laboratory QC Samples**

#### **4.3.1 TEM Analytical Laboratory QC**

##### **Laboratory Blanks**

A laboratory blank for TEM is a grid that is prepared from a new, un-used filter by the laboratory and is analyzed using the same procedure as used for field samples. The purpose of the laboratory blank is to determine if there are any significant sources of contamination arising during sample preparation or analysis in the laboratory. As specified in Libby Laboratory Modification #LB-000029B, laboratory blanks are to be analyzed at a frequency of 4%.

A total of 97 TEM laboratory blanks were analyzed by TEM during the time of the OU5 ABS programs (i.e., October 2007 to October 2008). No asbestos structures were observed in any laboratory blank sample. Based on these results, it is concluded that sample preparation and analysis procedures utilized within the analytical laboratories did not introduce asbestos contamination.

##### **Recounts**

A recount analysis is a re-examination of the original TEM grid openings to verify observed structure counts and characteristics. The following types of recount analyses were performed by each of the participating analytical laboratories during TEM analysis of ABS samples:

*Recount Same (RS)* – This is a TEM grid that is re-examined (same grid openings) by the same microscopist who performed the initial examination.

*Recount Different (RD)* – This is a TEM grid that is re-examined (same grid openings) by a different microscopist than who performed the initial examination.

*Verified Analysis (VA)* – This is a recount of a TEM grid (same grid openings) performed in accord with the protocol for verified analysis as provided in NIST (1994).

Recount analyses were compared with the original analysis on a grid opening-by-grid opening and structure-by-structure basis. Only those grid openings that were able to be re-examined during the recount analysis were included in this evaluation. The degree of agreement (concordance) between the original analysis and the recount analysis was evaluated based on the total number of countable LA structures observed for each grid opening that was re-examined. Specific concordance criteria are detailed in Libby Laboratory Modification #LB-000029B.

A total of 11 *Recount Same*, 11 *Recount Different*, and 12 *Verified Analysis* have been performed as part of the OU5 ABS programs. For these analyses, a total of 342 grid openings have been re-examined as part of a recount analysis. Table E-5 summarizes concordance results for each grid opening that was re-examined. In this table, results that are concordant (i.e., the LA structure count reported for the grid opening in the original analysis matches the

count reported in the recount analysis) are shaded in grey. As seen, concordance rates were good (100% agreement in total LA counts). These results show that LA structure counts by TEM are generally reproducible and that differences between TEM analysts are generally small and are not expected to influence the usability and interpretation of the ABS results.

### ***Repreparations***

A reparation by TEM is a grid that is prepared from a new portion of the same field sample filter as was used to prepare the original grid. Repreparation analyses are compared to the original analysis based on the Poisson rate ratio method recommended by Nelson (1982).

Repreparations were prepared for 5 air samples as part of the OU5 ABS programs. Table E-6 summarizes the results of both the original analysis and the reparation analysis. As seen, the total LA levels reported in the reparation analysis were not statistically different from the original analysis for all samples. These results show that LA results are reproducible and that TEM analytical precision is not likely to be impacted by preparation methods.

#### ***4.3.2 PLM Analytical Laboratory QC***

### ***Laboratory Duplicates***

For PLM-VE, a laboratory duplicate is a re-preparation of a soil sample slide by a different analyst (but within the same laboratory) than who performed the original analysis. Concordance between the laboratory duplicate analysis and the original analysis is evaluated using a methodology similar to that described above for field duplicates.

Table E-7 summarizes the original and laboratory duplicate results for PLM-VE. As seen, in all instances, both the original sample result and the laboratory duplicate result were ranked as concordant. These results support the conclusion that the soil sample results for PLM-VE are reproducible and reliable and are not greatly influenced by differences in laboratory analysis techniques between analysts.

### ***Interlab Samples***

For PLM-VE, an interlab analysis is performed by re-analysis of an independent aliquot of the original soil sample by an analyst from a different laboratory than who performed the initial analysis. The interlab analysis is blind to the interlab (i.e., the interlab cannot distinguish the interlab sample from other field samples on the field chain of custody form). Concordance between the interlab analysis and the original analysis is evaluated using a methodology similar to that described above for field duplicates.

Table E-8 summarizes the original and interlab results for samples collected as part of the OU5 ABS program. As seen, 23 out of 27 samples were concordant and 2 of 27 were weakly discordant, no samples were ranked as strongly discordant. These weak discordances may be due to analytical variability, or might arise from authentic small scale heterogeneity between soil aliquots drawn from the same sample bottle. These results support the conclusion that the soil

sample results for PLM-VE are reproducible and reliable and are not greatly influenced by differences in analysis techniques across laboratories.

#### **4.4 QC Conclusions**

Based on the results of the QC evaluation, it is concluded that:

- Inadvertent contamination of air, dust, and soil field samples with LA is not of significant concern, either in the field or the laboratory.
- TEM precision is generally good, as indicated by high agreement rates between field samples and field replicates/duplicates, between original and re-preparation analyses, and between original and recount analyses (i.e., samples where the same grid openings are evaluated twice).
- PLM-VE precision is generally good, as indicated by high concordance rates between field samples and matched field duplicates, preparation splits, laboratory duplicates, and interlab samples.
- PLM-VE accuracy is also generally good, as indicated by the concordance rates when analyzing PE samples. When results were discordant, the laboratories tended to overestimate LA levels in soil compared to nominal levels (i.e., results were biased high).

### **5 Data Adequacy Evaluation**

The following sections present a data adequacy evaluation to determine if available ABS air and soil data for OU5 are sufficient to allow risk managers to make informed decisions about potential risks to human health. This evaluation includes a comparison of the data collected with the specified data quality objectives (DQOs) stated in the respective ABS SAPs.

#### **5.1 Moto-X Park ABS Samples**

##### **5.1.1 Sample Representativeness**

The goal of the Moto-X Park ABS program (EPA 2008a) was to collect data which provide a reasonable representation of activities at the Moto-X Park that may result in exposures to LA in air. All ABS samples were collected from the Moto-X track during activities consistent with site use (e.g., during motorcycle use). Samples were collected in mid-September, during the part of the year when riding activities are expected to occur and when soil conditions are driest. Based on this, the Moto-X ABS data collected are deemed to be representative.

##### **5.1.2 Sample Completeness**

Completeness is defined as the fraction of samples that were planned that were successfully collected and analyzed. The Moto-X ABS SAP (EPA 2008a) recommended the collection of 24-32 personal air samples (6-8 individuals, 2 rides per person, on 2 different days) to characterize

rider exposures and 10 stationary air samples to characterize spectator exposures. The Moto-X ABS program collected and analyzed 24 personal air samples and 10 stationary air samples.

The Moto-X ABS SAP also recommended the collection of a 30-point composite soil sample from the Moto-X track for analysis by PLM-VE. A single 30-point composite soil sample was collected from the Moto-X track at the time of the ABS sampling. At the time of collection, the field teams recorded estimated visual vermiculite levels at each sampling point. This sample was also analyzed by PLM-VE.

Thus, all air and soil samples specified in the SAP were successfully collected and analyzed (i.e., 100% completeness).

### ***5.1.3 Analytical Sensitivity***

As specified in the Moto-X ABS SAP (EPA 2008a), the target analytical sensitivity was  $0.01 \text{ cc}^{-1}$  for personal air monitors and  $0.001 \text{ cc}^{-1}$  for stationary air monitors. All personal air samples and most stationary air samples achieved the target analytical sensitivity. Three of the 10 stationary air samples achieved sensitivities slightly higher than the target, with values ranging from  $0.0013$  to  $0.0015 \text{ cc}^{-1}$ . The consequence of this is that the concentration estimates for these samples have somewhat higher uncertainty than would have been achieved if the samples had been analyzed until the analytical sensitivity was achieved. However, it is not expected that this leads to any bias in the data, so the overall impact on data quality is not expected to be significant.

## **5.2 Recreational Visitor ABS Samples**

### ***5.2.1 Sample Representativeness***

The goal of the Recreational Visitor ABS program (EPA 2008c) was to collect data which provide a reasonable representation of recreational activities at the OU5 Site that may result in exposures to LA in air. All ABS air samples were collected from the recreational path along Libby Creek during activities consistent with site use (e.g., bicycle use). Sampling was conducted across the entirety of the recreational path, including both paved and unpaved sections. Samples were collected in mid-September, during the part of the year when recreational activities are expected to occur and when soil conditions are driest. Based on this, the Recreational Visitor ABS data collected are deemed to be representative.

### ***5.2.2 Sample Completeness***

The Recreational Visitor ABS SAP (EPA 2008c) recommended a minimum of 24 ABS air samples from each portion of the path (paved and unpaved) to represent adult exposures (3 individuals, 2 rides per day, 4 separate days). In addition, the SAP recommended the collection of 8 trailer ABS air samples from the paved path to represent child exposures (1 sample per ride, 2 rides per day, 4 separate days).

The Recreational Visitor ABS program collected and analyzed 21 personal air samples from each portion of the path (paved and unpaved) and 7 trailer air. Although the number of samples was slightly lower than the specified targets, because the underlying variability in these ABS air samples was generally small and concentrations were well below decision thresholds (see Section 7, Human Health Risk Assessment, of the OU5 Remedial Investigation Report), the number of ABS air samples collected is deemed adequate to support decision making.

### *5.2.3 Analytical Sensitivity*

As specified in the Recreational Visitor ABS SAP (EPA 2008c), the target analytical sensitivity for all personal air samples was  $0.006 \text{ cc}^{-1}$ . All ABS air samples achieved the target analytical sensitivity (most samples achieved a lower sensitivity of  $0.001 \text{ cc}^{-1}$ ).

## **5.3 Indoor Worker ABS Samples**

### *5.3.1 Sample Representativeness*

The goal of the Indoor Worker ABS program (EPA 2007) was to collect data which provide information on worker exposures inside buildings at the OU5 Site to determine if cleanup actions taken to date have reduced LA contamination to a level that is health-protective. For occupied OU5 buildings, ABS air samples were collected under disturbance scenarios that were representative of worker activities (both active and passive behavior conditions). For vacant OU5 buildings, ABS air samples were representative of a high-end disturbance scenario (following disturbance with a leaf-blower). Although it is likely that indoor air concentrations may vary over time, the focus of the ABS program was to estimate conservative (high-end) levels, so repeated sampling over time was not deemed necessary (EPA 2007).

### *5.3.2 Sample Completeness*

The Indoor Worker ABS SAP (EPA 2007) recommended the collection of 5 stationary air samples from vacant buildings and a single 2-hour personal air sample for each disturbance scenario (active and passive behaviors) from occupied buildings. All buildings that were deemed “habitable” (i.e., having four exterior walls, a roof, and a floor that was not soil) were to be sampled.

A total of 20 buildings (13 vacant buildings and 7 occupied) were deemed “habitable” at the time of the ABS investigation (November/December 2007). Since this time, 2 vacant buildings originally sampled have either burned (plywood plant) or been demolished (log yard pump house). In addition, one vacant building (boundary injection building) that was originally within the OU5 boundary is outside the current boundary of OU5. For the remaining vacant buildings, a total of 50 stationary air samples (5 samples from each of 10 buildings<sup>1</sup>). For the occupied buildings, a total of 29 ABS samples were collected during active behaviors and 9 ABS samples were collected during passive behaviors. The number of active behavior samples collected is higher than expected because the 2-hour time interval was split across multiple samples (e.g.,

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<sup>1</sup> One vacant building – the finger jointer processing plant – was not sampled.

collected at 30-minute or 60-minute intervals) to reduce the potential for particulate overloading on the filters. The number of passive behavior samples collected is higher than expected because activities conducted in the CDM office were separated into upstairs and downstairs.

Thus, with the exception of the finger jointer processing plant, all ABS air samples specified in the SAP were successfully collected and analyzed. Depending upon the future use of the finger jointer processing plant, measured ABS data may be needed for this building to inform risk management decisions.

### 5.3.3 Analytical Sensitivity

As specified in the Indoor Worker ABS SAP (EPA 2007), the target analytical sensitivity for all Indoor ABS air samples was  $0.0005 \text{ cc}^{-1}$ . All passive personal ABS air samples from occupied buildings achieved the target analytical sensitivity. For active personal ABS air samples, because multiple samples were collected across the 2-hour activity duration from each building, the adequacy of the achieved analytical sensitivity for these samples was evaluated based on the “pooled” sensitivity across samples, which was calculated as:

$$\text{Pooled Sensitivity (cc}^{-1}\text{)} = 1 / 3 \text{ TAE}_i \text{ (cc)}$$

where:

$\text{TAE}_i$  = Total amount of volume evaluated in sample analysis “i” (cc). The  $\text{TAE}_i$  is equal to  $1/\text{sensitivity in analysis “i”}$ .

The pooled sensitivity across active ABS samples did not achieve the target sensitivity for 4 of the 8 occupied buildings. In addition, one or more stationary ABS air samples collected from 4 of the 10 vacant buildings also did not achieve the target sensitivity. When the target analytical sensitivity was not achieved, it was due to high particulate overloading on the filter which required indirect preparation, and high dilutions were typically necessary to achieve optimal grid loading (i.e., f-factors tended to be small). Thus, in most cases, the analysis was stopped because the maximum grid opening stopping rule was reached (i.e., 100 grid openings were evaluated).

As noted previously, the consequence of not achieving the target analytical sensitivity is that the air concentration estimates for these samples have somewhat higher uncertainty than if the samples had achieved the target analytical sensitivity. However, it is not expected that this leads to any bias in the data. Estimated risks to indoor workers were within EPA’s acceptable risk range despite the elevated analytical sensitivities (see Section 7, Human Health Risk Assessment, of the OU5 Remedial Investigation Report). Thus, the available ABS air samples are deemed to be adequate to support decision making.

## **5.4 Outdoor Worker ABS Samples**

### **5.4.1 Sample Representativeness**

The goal of the Outdoor Worker ABS program (EPA 2008b) was to collect data which provide a reasonable representation of outdoor worker exposures during soil disturbance activities. Because it is not feasible to conduct outdoor ABS sampling on every acre of the OU5 Site, ABS was performed at eight 1-1.5 acre areas. These eight ABS areas were selected based on previous visible vermiculite sampling results to represent the range of expected soil contamination conditions at the OU5 Site, with Area 1 representing the low end of the soil range and Area 8 representing the high end of the range. At each ABS area, personal air samples were collected to represent two activities – raking and operating heavy machinery – which are considered to be general examples of relatively vigorous soil disturbances that may occur at the OU5 Site. Although it is likely that outdoor air concentrations may vary over time, the focus of the ABS program was to estimate conservative (high-end) levels during a time period when LA-releasability from soil was likely to be highest (i.e., during summer/fall) (EPA 2008b).

### **5.4.2 Sample Completeness**

The Outdoor Worker ABS SAP (EPA 2008b) recommended the collection of a minimum of 4 personal air samples per ABS area (4 samples x 8 areas = 32 samples). As part of the Outdoor Worker ABS program, two workers wore personal air monitors while performing scripted raking and bobcat operation activities at each ABS area during 3 separate sampling events (2 workers x 8 areas x 3 events = 48 samples). A total of 6 ABS air samples per ABS area were collected and successfully analyzed (i.e., >100% completeness).

The Outdoor Worker ABS SAP also recommended the collection of a 30-point composite soil sample and 30 individual grab samples from each ABS area during each event for analysis by PLM-VE. All soil samples were successfully collected and visual vermiculite estimates were recorded for three 30-point composite samples (1 composite per event) and three sets of 30 grab samples (1 set of 30 grabs per event). Based on the preliminary PLM-VE results from Round 1, nearly all samples at all ABS areas were non-detect. Therefore, EPA decided to suspend the PLM-VE analysis of soil samples collected in Round 2 and 3 (see LFO-000141 for documentation of the suspension of analysis). A total of 16/24 composite samples (67%) and 445/720 grab samples (62%) were analyzed by PLM-VE. Visible vermiculite estimates were recorded for all soil sampling points during each event (100% completeness). Although only about 2/3 of the samples were analyzed by PLM-VE, comparisons of PLM-VE results to visible vermiculite estimates from other ABS programs suggest that visible vermiculite inspection results may be a somewhat more sensitive method for detecting contamination in soil than PLM-VE analysis of 30-point composite sample (EPA 2010). Therefore, the fact that not all soil samples were analyzed by PLM-VE is not deemed to be an important data limitation.

### **5.4.3 Analytical Sensitivity**

As specified in the Outdoor Worker ABS SAP (EPA 2008b), the target analytical sensitivity for all outdoor worker ABS air samples was 0.001 cc<sup>-1</sup>. The target analytical sensitivity was not

achieved in 30 of 48 ABS air samples. As noted previously, the consequence of not achieving the target analytical sensitivity is that the air concentration estimates for these samples will have a higher degree of uncertainty. However, despite the fact that the target analytical sensitivity was not achieved for all individual samples, it is still possible for risk managers to make informed decisions for outdoor worker exposures. This is because the exposure point concentrations for outdoor workers used in the risk assessment are based on the average across ABS samples evaluating non-detects at zero. This approach yields an unbiased estimate of the true mean that does not depend on the analytical sensitivity of the samples included in the data set. Estimated risks to outdoor workers were within EPA's acceptable risk range despite the elevated analytical sensitivities (see Section 7, Human Health Risk Assessment, of the OU5 Remedial Investigation Report). Thus, the available ABS air samples are deemed to be adequate to support decision making.

### **5.5 Site-wide Surface Soil Samples**

As described in the risk assessment (Section 7 of the OU5 Remedial Investigation Report), because it is not feasible to evaluate risks by conducting outdoor worker ABS sampling on every acre of the OU5 Site, it is necessary to draw risk conclusions about areas that have not been studied by ABS by assessing whether soil results from these areas are similar to the soil contamination levels in the Outdoor Worker ABS areas. Therefore, available soil samples must be representative of the entire OU5 Site and must have been sampled and analyzed using appropriate methods.

Outside of the ABS efforts, there have been three major site-wide surface soil sampling programs conducted at the OU5 Site. Each of these programs is described briefly below:

**Contaminant Screening Study (October 2002):** As part of the Contaminant Screening Study (CSS), the OU5 Site was divided into seven sample collection areas based on land use – Former Popping Plant, Railroad Spur, Lumber Yard, Log Storage Area, Southwest Area, Former Champion Tree Nursery, and the Libby Groundwater Superfund Site. A total of 103 surface soil samples (generally 5-point composites) were collected from these areas in October 2002. All soil samples were analyzed by PLM-VE. At the time of sample collection, the field teams recorded qualitative information on the presence/absence of visible vermiculite for the soil sample in the field logbooks. Visible vermiculite was not reported in any soil sample collected (CDM 2007a). Only 2 surface soil samples had detectable levels of LA reported by PLM-VE – one sample from the former tree nursery and one sample from the southwest area near the Luck E G Post & Rail Company operations reported Bin B1 (trace) levels in soil.

**OU5 Soil Data Gap Study, Part I (October 2007):** In October 2007, a second site-wide soil sampling program was conducted to address soil data gaps and further characterize areas with LA soil contamination at the OU5 Site (CDM 2007b). Sampling efforts focused on soil collection from the Libby Groundwater Superfund Site, the Former Champion Tree Nursery, the banks of Libby Creek, the Stormwater Containment/Waste Water Lagoon Area (an area which was not sampled during the CSS), and the Southwest Area (where trace levels were noted in the CSS). A total of 180 surface soil

samples (30-point composites) were collected from these areas and analyzed by PLM-VE. At the time of sample collection, the field teams recorded semi-quantitative visible vermiculite estimates at each soil sampling point in accord with SOP CDM-LIBBY-06. Detailed PLM-VE and visual vermiculite inspection results from this soil sampling program are summarized in CDM (2008a) *Sampling Summary Report – 2007 Investigations*.

**OU5 Soil Data Gap Study, Part II (June/July 2008):** During the analysis of the 2007 soil data gap samples, an additional data gap was identified for areas that were only sampled during the CSS in 2002 (CDM 2008b). Although CSS soil samples were available from these areas, the samples were not representative of more current collection protocols (i.e., samples were 5-point composite samples as opposed to 30-point composites and visual vermiculite information was only qualitative as opposed to semi-quantitative). Therefore, additional sampling was performed in June/July 2008 at the Moto-X Park, the Lumber Yard, the Southwest Area, the Railroad Spur, and the Log Storage Area. A total of 73 surface soil samples (30-point composites) were collected from these areas and analyzed by PLM-VE. At the time of sample collection, the field teams recorded semi-quantitative visible vermiculite estimates at each soil sampling point in accord with SOP CDM-LIBBY-06.

Figures 5.4 and 5.5 in the Remedial Investigation Report illustrate the site-wide soil contamination conditions at the OU5 Site based on PLM results and visual vermiculite inspection results, respectively. In interpreting these figures, it is important to remember that composite samples are representative of a larger area than the plotting point presented in the map. As seen, PLM-VE results and/or visible vermiculite information for soil is available for most of the OU5 Site. There are two general areas where soil data is not available:

- Within the Stormwater Containment and Waste Water Lagoon Area, large portions of this area were not sampled since they were forested areas and not expected to be used commercially (CDM 2008a). Measured soil data may be needed from these forested areas to characterize potential soil contamination depending upon the intended future land use.
- Within the Libby Superfund Groundwater Site, the Land Treatment Unit (LTU) cells were not sampled in October 2007 due to ongoing remedial activities (CDM 2008a). The Landfarm area was also not sampled in October 2007 because there was a concern that the clean top layer of soil could be contaminated by impacted subsurface soils during sampling (CDM 2008a). Subsurface soils from the Landfarm area were subsequently sampled in October 2008. A total of 51 grab samples (12-15 inches) were collected and analyzed by PLM-VE. All samples were reported as non-detect by PLM and visible vermiculite was only observed in one sample. The LTUs and Landfarm area are being remediated separately, as part of the Libby Superfund Groundwater Site.

## 6 DQA Conclusions

Taken together, these results indicate that air and soil data collected at the OU5 Site and utilized in this risk assessment generally are of acceptable quality, adequate and representative, and considered to be reliable and appropriate for use in the risk assessment.

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**Table E-1. Impact Assessment for Field and Laboratory Modifications**

| Type       | Number     | Effective Date | Description                                                                                                                                                                                                                              | Impact on Data Evaluation                                                                                                                                                                                                                                                   |
|------------|------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Field Mods | LFO-000134 | 9/8/2008       | Specifies TEM analysis stopping rules in the Moto-X ABS SAP in terms of area examined rather than grid openings evaluated. Modification will standardize stopping rules across laboratories that may use grid openings of varying sizes. | None.                                                                                                                                                                                                                                                                       |
|            | LFO-000141 | 1/13/2009      | Modifies the Moto-X ABS SAP and Outdoor Worker ABS SAP to incorporate a phased approach for the PLM and fluidized bed analysis of collected soil samples.                                                                                | Although this modification reduces the number of soil samples analyzed, corresponding visual soil inspection and ABS air data indicate that soil contamination is fairly uniform and may not support a quantitative regression analysis.                                    |
|            | LFO-000145 | 5/11/2009      | Modifies the number and types of soil samples that will be analyzed by the fluidized bed approach.                                                                                                                                       | None.                                                                                                                                                                                                                                                                       |
| Lab Mods   | LB-000076  | 11/12/2007     | Analysis of the ABS air samples in lab job EMSL 270701088 (L13120) was terminated at 100 grid openings rather than terminating at the target analytical sensitivity specified in the ABS SAP.                                            | If 50 LA structures are recorded, then there is no impact on data quality. If counting is stopped at 100 GOs and structure count is low (e.g., <10), then there will be increased uncertainty in the estimates of concentration. However, there is no introduction of bias. |
|            | LB-000081  | 11/26/2008     | Analysis of the ABS air samples in lab job EMSL 040729249 (L13283) was terminated at 100 grid openings rather than terminating at the target analytical sensitivity specified in the ABS SAP.                                            |                                                                                                                                                                                                                                                                             |
|            | LB-000077  | 10/30/2007     | ABS Field Blanks - 30 grid opening stopping rule for all air and dust field blanks.                                                                                                                                                      | None.                                                                                                                                                                                                                                                                       |
|            | LB-000086  | 4/22/2008      | All samples analyzed by SRC-Libby-03 (PLM-VE) shall be referenced by the use of a concatenation of the Index ID, Suffix ID, and the Suffix # (e.g. 1D-00827-FG2).                                                                        | None.                                                                                                                                                                                                                                                                       |

**Table E-2. Results of Air Field Replicates and Dust Field Duplicates Analyzed by TEM**

| Media | Original Sample |               |            |                 |             |     |     |         |          |        |            |                                                | Field Duplicate Sample |               |            |                 |             |     |     |         |          |        |            |                                                | Poisson Rate Comparison (95% CI)               |
|-------|-----------------|---------------|------------|-----------------|-------------|-----|-----|---------|----------|--------|------------|------------------------------------------------|------------------------|---------------|------------|-----------------|-------------|-----|-----|---------|----------|--------|------------|------------------------------------------------|------------------------------------------------|
|       | Index ID        | Analysis Date | Lab Name   | Analysis Method | Prep Method | EFA | Gox | GO Size | F Factor | Sens   | N LA Struc | LA Conc (s/cc) or Loading (s/cm <sup>2</sup> ) | Index ID               | Analysis Date | Lab Name   | Analysis Method | Prep Method | EFA | Gox | GO Size | F Factor | Sens   | N LA Struc | LA Conc (s/cc) or Loading (s/cm <sup>2</sup> ) |                                                |
| Air   | SL-00024        | 9/16/02       | RESI       | AHERA           | DIRECT      | 385 | 4   | 0.011   | 1        | 0.0018 | 0          | 0                                              | SL-00023               | 9/16/02       | RESI       | AHERA           | DIRECT      | 385 | 4   | 0.011   | 1        | 0.0018 | 0          | 0                                              | Both counts are 0; the rates are not different |
|       | SL-00024        | 9/16/02       | RESI       | ISO             | DIRECT      | 385 | 10  | 0.011   | 1        | 0.0007 | 0          | 0                                              | SL-00023               | 9/16/02       | RESI       | ISO             | DIRECT      | 385 | 10  | 0.011   | 1        | 0.0007 | 0          | 0                                              | Both counts are 0; the rates are not different |
|       | SL-00214        | 9/19/02       | Mobile Lab | AHERA           | DIRECT      | 385 | 4   | 0.0129  | 1        | 0.0034 | 0          | 0                                              | SL-00213               | 9/19/02       | Mobile Lab | AHERA           | DIRECT      | 385 | 4   | 0.0129  | 1        | 0.0034 | 0          | 0                                              | Both counts are 0; the rates are not different |
|       | SL-00214        | 10/2/02       | Westmont   | ISO             | DIRECT      | 385 | 10  | 0.0064  | 1        | 0.0028 | 0          | 0                                              | SL-00213               | 10/2/02       | Westmont   | ISO             | DIRECT      | 385 | 10  | 0.0064  | 1        | 0.0028 | 0          | 0                                              | Both counts are 0; the rates are not different |
|       | SL-00223        | 9/19/02       | Mobile Lab | AHERA           | DIRECT      | 385 | 4   | 0.0129  | 1        | 0.0025 | 0          | 0                                              | SL-00222               | 9/19/02       | Mobile Lab | AHERA           | DIRECT      | 385 | 4   | 0.0129  | 1        | 0.0025 | 0          | 0                                              | Both counts are 0; the rates are not different |
|       | SL-00223        | 10/2/02       | Westmont   | ISO             | DIRECT      | 385 | 10  | 0.0064  | 1        | 0.0021 | 0          | 0                                              | SL-00222               | 10/2/02       | Westmont   | ISO             | DIRECT      | 385 | 10  | 0.0064  | 1        | 0.0020 | 0          | 0                                              | Both counts are 0; the rates are not different |
| Dust  | SL-70653        | 1/23/08       | Hygeia     | ISO             | INDIRECT    | 346 | 5   | 0.01    | 0.15     | 46.1   | 0          | 0                                              | SL-70655               | 1/23/08       | Hygeia     | ISO             | INDIRECT    | 346 | 5   | 0.01    | 0.15     | 46.1   | 0          | 0                                              | Both counts are 0; the rates are not different |
|       | SL-70497        | 12/28/07      | RESI       | ISO             | INDIRECT    | 346 | 10  | 0.011   | 0.25     | 12.6   | 0          | 0                                              | SL-70498               | 12/28/07      | RESI       | ISO             | INDIRECT    | 346 | 10  | 0.011   | 0.5      | 6.3    | 1          | 6.3                                            | [0-78] The rates are not different             |

**Table E-3. Evaluation of Field Duplicates Analyzed by PLM-VE**

|                         |              | Field Duplicate Results |             |              |             |
|-------------------------|--------------|-------------------------|-------------|--------------|-------------|
|                         |              | Bin A (ND)              | Bin B1 (Tr) | Bin B2 (<1%) | Bin C (≥1%) |
| Original Sample Results | Bin A (ND)   | 35                      | 1           | 0            | 0           |
|                         | Bin B1 (Tr)  | 1                       | 0           | 0            | 0           |
|                         | Bin B2 (<1%) | 0                       | 0           | 0            | 0           |
|                         | Bin C (≥1%)  | 0                       | 0           | 0            | 0           |

|                     | <u>incl. ND</u> | <u>excl. ND</u> |
|---------------------|-----------------|-----------------|
| Total Pairs         | 37              | 2               |
| Concordant          | 35 (94.6%)      | 0 (0%)          |
| Weakly Discordant   | 2 (5.4%)        | 2 (100%)        |
| Strongly Discordant | 0 (0%)          | 0 (0%)          |

**Table E-4. Evaluation of Preparation Split Analyzed by PLM-VE**

|                         |              | Preparation Split Results |             |              |             |
|-------------------------|--------------|---------------------------|-------------|--------------|-------------|
|                         |              | Bin A (ND)                | Bin B1 (Tr) | Bin B2 (<1%) | Bin C (≥1%) |
| Original Sample Results | Bin A (ND)   | 42                        | 0           | 0            | 0           |
|                         | Bin B1 (Tr)  | 0                         | 0           | 0            | 0           |
|                         | Bin B2 (<1%) | 0                         | 0           | 0            | 0           |
|                         | Bin C (≥1%)  | 0                         | 0           | 0            | 0           |

|                     |           |
|---------------------|-----------|
| Total Pairs         | 42        |
| Concordant          | 42 (100%) |
| Weakly Discordant   | 0 (0%)    |
| Strongly Discordant | 0 (0%)    |

**Table E-5. Comparison of Number of  
Countable LA Structures Recorded in the  
Original Analysis and Recount Analysis**

| # of LA Structures<br>in Unique GO |   | Recount Analysis Results |    |   |   |
|------------------------------------|---|--------------------------|----|---|---|
|                                    |   | 0                        | 1  | 2 | 3 |
| Original<br>Analysis<br>Results    | 0 | 326                      | 0  | 0 | 0 |
|                                    | 1 | 0                        | 15 | 0 | 0 |
|                                    | 2 | 0                        | 0  | 0 | 0 |
|                                    | 3 | 0                        | 0  | 0 | 1 |

Total Pairs                      342

Match                              342 (100%)

Off by 1 Structure    0 (0%)

Off by >1 Structure   0 (0%)

Table E-6. TEM Repreparation Results for Air

| Analysis Details |                 |             | Original Analysis Results |            |               |            |             |                        | Repreparation Analysis Results |            |               |            |             |                        | Poisson Rate Comparison (95% CI)               |
|------------------|-----------------|-------------|---------------------------|------------|---------------|------------|-------------|------------------------|--------------------------------|------------|---------------|------------|-------------|------------------------|------------------------------------------------|
| Index ID         | Analysis Method | Prep Method | Analysis/ DSeqN           | Lab Name   | Analysis Date | N LA Struc | Sensitivity | Total LA Conc/ Loading | Analysis/ DSeqN                | Lab Name   | Analysis Date | N LA Struc | Sensitivity | Total LA Conc/ Loading |                                                |
| SL-00038         | TEM-ISO10312    | DIRECT      | 33027                     | RESI       | 9/16/2002     | 0          | --          | 0.0E+00                | 33018                          | RESI       | 9/17/2002     | 0          | --          | 0.0E+00                | Both counts are 0; the rates are not different |
| SL-00159         | TEM-ISO10312    | DIRECT      | 33974                     | Hygeia     | 10/2/2002     | 0          | 1.4E-02     | 0.0E+00                | 34862                          | Hygeia     | 10/12/2002    | 0          | 1.4E-02     | 0.0E+00                | Both counts are 0; the rates are not different |
| SL-00300         | TEM-ISO10312    | DIRECT      | 185204                    | Mobile Lab | 11/3/2008     | 0          | 9.6E-04     | 0.0E+00                | 187175                         | Mobile Lab | 12/1/2008     | 0          | 1.7E-03     | 0.0E+00                | Both counts are 0; the rates are not different |
| SL-00399         | TEM-ISO10312    | DIRECT      | 182724                    | RESI       | 10/6/2008     | 0          | 9.1E-04     | 0.0E+00                | 182725                         | RESI       | 10/7/2008     | 1          | 8.8E-04     | 8.8E-04                | [0-40.42] The rates are not different          |
| SL-70787         | TEM-ISO10312    | DIRECT      | 179270                    | MAS        | 7/31/2008     | 0          | 5.0E-03     | 0.0E+00                | 179271                         | MAS        | 7/31/2008     | 0          | 4.9E-03     | 0.0E+00                | Both counts are 0; the rates are not different |

**Table E-7. Evaluation of Laboratory Duplicates Analyzed by PLM-VE**

| Cross-Check             |              | Laboratory Duplicate Results |             |              |             |
|-------------------------|--------------|------------------------------|-------------|--------------|-------------|
|                         |              | Bin A (ND)                   | Bin B1 (Tr) | Bin B2 (<1%) | Bin C (≥1%) |
| Original Sample Results | Bin A (ND)   | 64                           | 0           | 0            | 0           |
|                         | Bin B1 (Tr)  | 0                            | 4           | 0            | 0           |
|                         | Bin B2 (<1%) | 0                            | 0           | 0            | 0           |
|                         | Bin C (≥1%)  | 0                            | 0           | 0            | 0           |

|                     | <u>incl. ND</u> | <u>excl. ND</u> |
|---------------------|-----------------|-----------------|
| Total Pairs         | 68              | 4               |
| Concordant          | 68 (100%)       | 4 (100%)        |
| Weakly Discordant   | 0 (0%)          | 0 (0%)          |
| Strongly Discordant | 0 (0%)          | 0 (0%)          |

| Self-Check              |              | Laboratory Duplicate Results |             |              |             |
|-------------------------|--------------|------------------------------|-------------|--------------|-------------|
|                         |              | Bin A (ND)                   | Bin B1 (Tr) | Bin B2 (<1%) | Bin C (≥1%) |
| Original Sample Results | Bin A (ND)   | 58                           | 0           | 0            | 0           |
|                         | Bin B1 (Tr)  | 0                            | 0           | 0            | 0           |
|                         | Bin B2 (<1%) | 0                            | 0           | 0            | 0           |
|                         | Bin C (≥1%)  | 0                            | 0           | 0            | 0           |

|                     | <u>incl. ND</u> |
|---------------------|-----------------|
| Total Pairs         | 58              |
| Concordant          | 58 (100%)       |
| Weakly Discordant   | 0 (0%)          |
| Strongly Discordant | 0 (0%)          |

**Table E-8.**  
**Comparison of Interlabs Analyzed by PLM-VE**

|                         |              | Interlab Results |             |              |             |
|-------------------------|--------------|------------------|-------------|--------------|-------------|
|                         |              | Bin A (ND)       | Bin B1 (Tr) | Bin B2 (<1%) | Bin C (≥1%) |
| Original Sample Results | Bin A (ND)   | 22               | 1           | 0            | 0           |
|                         | Bin B1 (Tr)  | 3                | 1           | 0            | 0           |
|                         | Bin B2 (<1%) | 0                | 0           | 0            | 0           |
|                         | Bin C (≥1%)  | 0                | 0           | 0            | 0           |

|                     | <u>incl. ND</u> | <u>excl. ND</u> |
|---------------------|-----------------|-----------------|
| Total Pairs         | 27              | 5               |
| Concordant          | 23 (85.2%)      | 1 (20%)         |
| Weakly Discordant   | 4 (14.8%)       | 4 (80%)         |
| Strongly Discordant | 0 (0%)          | 0 (0%)          |

# TEM CONSISTENCY REVIEW AND DATA TRANSFER VERIFICATION REPORT

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Date: April 20, 2010

Prepared by: Natalie Ross

## **Validation of OU5 ABS Samples**

### ***SUMMARY OF FINDINGS AND DATA QUALITY IMPLICATIONS***

There were two findings that involve the incorrect transfer of data from the hardcopy report to the EDD. These issues include one instance of a structure length incorrectly entered in the EDD and one instance where the photo reference number was incorrect. There were two analyses that have duplicate entries in the database; a corrected EDD was uploaded to the database but the original EDD was not removed. In one analysis, the structure lengths were rounded up in the database and do not match the bench sheet. For example, the structure length written on the bench sheet is 0.05 but is rounded up to 0.1 in the database. In each instance, the mineral class for the structures was chrysotile so it does not impact calculations based on LA structures.

There were two analyses where the analyst was inconsistent in recording complex structures on the bench sheet and recorded dimensions of the entire matrix on the primary structure line. The primary structures were recorded on the bench sheet but not transferred to the EDD; the secondary structures were correctly recorded on the bench sheet and transferred to the EDD. In these cases, the laboratory should cross out the primary structure information (including length, width, identification and mineral class) on the bench sheet and initial. These issues were previously identified by Anni Autio on 4/4/2010.

One analysis was not originally selected for validation, however, after a general review for consistency in the database, there were two grid opening names that appeared to be incorrect so the analysis was selected for validation. In addition to the grid opening name errors for this analysis, there was one instance where the mineral class was unclear. It looks like a "1" is entered in the chrysotile box on the bench sheet, but the EDD has this structure identified as LA. The laboratory should verify the correct mineral class.

Recommendations for future review and verification:

The error rates in the validation were low and the issues found were not critical and did not impact the calculations for LA structures. Therefore, future validation is not needed.

# TEM CONSISTENCY REVIEW AND DATA TRANSFER VERIFICATION REPORT

## TEM-ISO 10312 SELECTION AND CONSISTENCY REVIEW RESULTS

Summary of available analyses for samples specified –

| Analyst, Laboratory  | Number of TEM-ISO 10312 Analyses |            |       | Number of Analyses Selected for Review |            |       |
|----------------------|----------------------------------|------------|-------|----------------------------------------|------------|-------|
|                      | Detect                           | Non-Detect | Total | Detect                                 | Non-Detect | Total |
| J. XU, Batta         | 7                                | 7          | 14    | 2                                      | 1          | 3     |
| K. Corbin, Hygeia    | 2                                | 0          | 2     | 1                                      | 0          | 1     |
| Q. Trieu, Hygeia     | 9                                | 1          | 10    | 2                                      | 1          | 3     |
| A. Keeton, MAS       | 3                                | 6          | 9     | 1                                      | 1          | 2     |
| K. Simpson, MAS      | 3                                | 1          | 4     | 1                                      | 1          | 2     |
| M. Motamedi, MAS     | 3                                | 11         | 14    | 1                                      | 1          | 2     |
| R. Mahoney, EMSL     | 7                                | 46         | 53    | 2                                      | 4          | 6     |
| R. Pescador, EMSL    | 13                               | 59         | 72    | 3                                      | 5          | 8     |
| A. Heitger, Resi     | 6                                | 3          | 9     | 1                                      | 1          | 2     |
| N. DelHiero, Resi    | 3                                | 1          | 4     | 1                                      | 1          | 2     |
| N. Zimbelman, Resi   | 26                               | 36         | 62    | 6                                      | 3          | 9     |
| G. Agnello, Westmont | 2                                | 1          | 3     | 1                                      | 1          | 2     |
| Total                | 84                               | 172        | 256   | 22                                     | 20         | 42    |

|                      | <u>Goal</u> | <u>Actual</u> |
|----------------------|-------------|---------------|
| Selected Total       | 26          | 42*           |
| Selected Detects     | 13          | 22            |
| Selected Non-Detects | 13          | 20            |

\*Note: Analysis SL-00397 was not included in the original selection but added after errors were found in the database

Detailed summary of bench sheet consistency review –

Number of analyses reviewed: 42 (10 % of total analyses selected)

Number of analyses with recording and data transfer issues identified: 8 (19% of total analyses reviewed)

Types of recording and data transfer issues identified (indicate the number of analyses):

- \_\_\_\_\_ Reported structure types are inconsistent with ISO guidance
- \_\_\_\_\_ Primary and/or total columns are not populated correctly
- \_\_\_\_\_ NAM structures are recorded and not identified as non-countable
- \_\_\_\_\_ Fibers recorded as countable do not meet aspect ratio criteria (LB-000016)
- 1 Mineral class designation is missing or inconsistent
- \_\_\_\_\_ Structure comments are inconsistent with LB-000066
- 1 Structure comments are inconsistent with recorded data
- 4 Structure attributes in the database do not match the bench sheet
- 2 Duplicate entries in database
- 2 Incorrect grid opening name

# TEM CONSISTENCY REVIEW AND DATA TRANSFER VERIFICATION REPORT

Do the recording issues identified appear to be associated with a particular analyst or laboratory? Yes ☐ No ☒

If yes, identify the analyst and/or laboratory: \_\_\_\_\_

## ISSUE RESOLUTION AND STATUS

Requested revisions for recording and data transfer issues were sent to Amy Christensen at ESAT on 4/20/2010. A summary of the requested revisions can be found in Table 1 below.

**Table 1. Requested Revisions for OU5 ABS Samples**

| Sample ID | Unique Grid Opening        | Laboratory Name | Laboratory Job Number | SRC Comments                                                                                                                                                                                                                                                                       | Database Revision | EDD/Benchsheet Revision |
|-----------|----------------------------|-----------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------------|
| SL-00430  | 1_A2,<br>1_G7              | Batta           | CDM-152               | Length, width, identification and mineral class for GOs 1_A2 (MD11) and 1_G7 (MD10) should be crossed out and initialed for the primary structures on benchsheet.                                                                                                                  |                   | x                       |
| SL-00431  | 1_C10                      | Batta           | CDM-152               | Length, width and identification for GO 1_C10 (MD10) should be crossed out and initialed for the primary structures on benchsheet.                                                                                                                                                 |                   | x                       |
| SL-70433  | Multiple                   | MAS             | M45425                | In 11 GOs, the length has been rounded in the database. For example, GO CI_G1, the length written on the benchsheet is 0.05 but is rounded to 0.1 in the database. The EDD needs to be reloaded into the database.                                                                 | x                 | x                       |
| SL-70361  | 2_E9                       | Mobile Lab      | 270701205             | Photo should be #04440 not #0440 in the EDD.                                                                                                                                                                                                                                       |                   | x                       |
| SL-70376  | Multiple                   | Mobile Lab      | 270800036             | Result information in the database is duplicated; both the original submitted EDD and the corrected EDD from 4/1/09 are in the database.                                                                                                                                           | x                 |                         |
| SL-70561  | Multiple                   | Mobile Lab      | 270800036             | Result information in the database is duplicated; both the original submitted EDD and the corrected EDD from 4/1/09 are in the database.                                                                                                                                           | x                 |                         |
| SL-00397  | A_A5-4<br>A_A5-1<br>B_B2-6 | RESI            | 161814                | GO name in database should be A_A5-4 not A_39577<br>GO name in database should be A_A5-1 not A_39574<br>Mineral class for GO B_B2-6 is unclear, need laboratory to clarify. It looks like a "1" is entered in the Chrysotile box, but the EDD has this structure identified as LA. |                   | x                       |
| SL-70683  | A_F2-3                     | RESI            | 148479                | Length should be 9 not 7 in the EDD.                                                                                                                                                                                                                                               |                   | x                       |

## PLM CONSISTENCY REVIEW AND DATA TRANSFER VERIFICATION REPORT

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Date: July 28, 2010

Prepared by:

Natalie Ross

### ***SUMMARY OF FINDINGS AND DATA QUALITY IMPLICATIONS***

The data verification identified errors in the reported PLM-VE bin for two soil samples. One analysis was not originally selected for validation, however, after a review of an analysis from the same laboratory job it became apparent that the results for the two samples were incorrectly entered in the EDD.

There were also several findings that involve the incorrect transfer of data from the hard copy report to the EDD. These issues include transfer errors of the analyst name, analysis date and laboratory job number. In several analyses, the laboratory inconsistently reported the Lab QA type on the bench sheet and recorded “LD” for both “Not QA” and “LD” samples. The laboratory should verify the correct QA Type and make revisions on the bench sheet.

Recommendations for future review and verification: The error rates in the validation were low and the issues found were not critical. Therefore, future validation is not needed.

# PLM CONSISTENCY REVIEW AND DATA TRANSFER VERIFICATION REPORT

## PLM SELECTION AND CONSISTENCY REVIEW RESULTS

Summary of available analyses for samples specified –

| Analyst, Lab         | Number of PLM Analyses |                       |       | Number of Analyses Selected for Review |                       |       |
|----------------------|------------------------|-----------------------|-------|----------------------------------------|-----------------------|-------|
|                      | Detect                 | Non-Detect<br>(Bin A) | Total | Detect                                 | Non-Detect<br>(Bin A) | Total |
| AK, Batta            | 0                      | 71                    | 71    | 0                                      | 4                     | 4     |
| JT, Batta            | 1                      | 47                    | 48    | 1                                      | 3                     | 4     |
| Douglas Kent, ESAT   | 5                      | 9                     | 14    | 4                                      | 1                     | 5     |
| Nikki McDonald, ESAT | 21                     | 20                    | 41    | 18                                     | 1                     | 19    |
| Talena Oliver, ESAT  | 4                      | 14                    | 18    | 3                                      | 1                     | 4     |
| A. Casas, Hygeia     | 0                      | 16                    | 16    | 0                                      | 1                     | 1     |
| F. Guiierrez, Hygeia | 0                      | 1                     | 1     | 0                                      | 1                     | 1     |
| G. Hernandez, Hygeia | 2                      | 130                   | 133   | 2                                      | 7                     | 9     |
| H. Espinoza, Hygeia  | 0                      | 1                     | 1     | 0                                      | 1                     | 1     |
| Derrill Duncan, MAS  | 0                      | 26                    | 26    | 0                                      | 1                     | 1     |
| Kevin Simpson, MAS   | 0                      | 11                    | 11    | 0                                      | 1                     | 1     |
| PMHess, MAS          | 0                      | 34                    | 34    | 0                                      | 2                     | 2     |
| WB Egeland, MAS      | 0                      | 62                    | 62    | 0                                      | 3                     | 3     |
| Mobile Lab           | 5                      | 17                    | 22    | 4                                      | 1                     | 5     |
| LW, RESI             | 0                      | 2                     | 2     | 0                                      | 1                     | 1     |
| NRA, RESI            | 0                      | 1                     | 1     | 0                                      | 1                     | 1     |
| PDL, RESI            | 0                      | 1                     | 1     | 0                                      | 1                     | 1     |
| PFK, RESI            | 0                      | 1                     | 1     | 0                                      | 1                     | 1     |
| RSW, RESI            | 21                     | 461                   | 480   | 18                                     | 25                    | 43    |
| D. Beard, Westmont   | 0                      | 1                     | 2     | 0                                      | 1                     | 1     |
| Total                | 59                     | 926                   | 985   | 50                                     | 58                    | 108   |

|                      | <u>Goal</u> | <u>Actual</u> |
|----------------------|-------------|---------------|
| Selected Total       | 99          | 108*          |
| Selected Detects     | 50          | 50            |
| Selected Non-Detects | 50          | 58            |

\*Note: Analysis SL-70071 was not included in the original selection but added after errors were found in another analysis

Detailed summary of bench sheet consistency review –

Number of analyses reviewed: 108 (10% of total analyses selected)

If not all analyses could be reviewed, provide a brief explanation for why: N/A

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## PLM CONSISTENCY REVIEW AND DATA TRANSFER VERIFICATION REPORT

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Number of analyses with recording and data transfer issues identified: 16 (15% of total analyses reviewed)

Types of recording issues identified (indicate the number of analyses):

7 Incorrect/missing information on analysis details (e.g., lab job number, analysis date)

         Reported value does not use correct binning category.

Data Transfer issues identified:

7 Incorrect/missing information on analysis details (e.g., lab job number, analysis date)

2 Reported value does not use correct binning category.

Do the recording or data transfer issues identified appear to be associated with a particular analyst or laboratory?

Yes ☐ No ☒

If yes, identify the analyst and/or laboratory: \_\_\_\_\_

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### ISSUE RESOLUTION AND STATUS

A summary of the EDD/bench sheet revisions can be found in Table 1 below.

**Table 1. Requested Revisions for OU5 ABS Samples**

| Sample ID                        | Laboratory Name                   | Laboratory Job Number | SRC Notes                                                                              |
|----------------------------------|-----------------------------------|-----------------------|----------------------------------------------------------------------------------------|
| 2R-05230<br>2R-05282<br>2R-05283 | Mobile Lab                        | 270900114             | Analyst name written on the bench sheet but not entered in the EDD                     |
| 1-09011<br>1-09013               | Mobile Lab                        | 270900476             | Analyst name written on the bench sheet but not entered in the EDD                     |
| CS-09300                         | Reservoirs Environmental Services | 102783                | QA Type on bench sheet does not match the EDD.                                         |
| CS-09596                         | Reservoirs Environmental Services | 102783                | QA Type on bench sheet does not match the EDD.                                         |
| CS-09705                         | Reservoirs Environmental Services | 103573                | Analysis date on bench sheet (4/10/2004) does not match the date in the EDD (4/9/2004) |
| CS-18489                         | Reservoirs Environmental Services | 105080                | QA Type on bench sheet does not match the EDD.                                         |
| CS-18583                         | Reservoirs Environmental Services | 107324                | QA Type on bench sheet does not match the EDD.                                         |
| SL-70071                         | Reservoirs Environmental Services | 146149                | Reported value should be "1" not "ND"                                                  |
| SL-70072                         | Reservoirs Environmental Services | 146149                | Reported value should be "ND" not "1"                                                  |
| SL-70295                         | Reservoirs Environmental Services | 148239                | QA Type on bench sheet does not match the EDD.                                         |
| SL-70335                         | Reservoirs Environmental Services | 149474                | QA Type on bench sheet does not match the EDD.                                         |
| SL-00634                         | Reservoirs Environmental Services | 164190                | QA Type on bench sheet does not match the EDD.                                         |
| SL-70057                         | Westmont                          | 40809060              | Laboratory job number on bench sheet is written as both 04080960 and 040809060         |

# **Appendix F**

## **Supplemental Investigation Reports**

# **Appendix F1**

## **Wood Chip ABS**



## Memorandum

*To: Rebecca Thomas, EPA Remedial Project Manager*

*From: Nick Raines, CDM Smith Project Manager*

*Date: January 9, 2012*

*Subject: OU5 Wood Chip Activity-base Sampling Summary*

## Background

Operable Unit 5 (OU5) of the Site, the former Stimson Lumber Mill site, is located in the eastern portion of Libby. Historically, a variety of wood treatment and lumber milling processes were performed at OU5. The majority of lumber production activities ceased in 2003. Several wood chip piles from historical lumber processing activities were left at OU5. Wood chips from these piles have been sold and given away for use as landscaping mulch in gardens, flowerbeds, playgrounds, etc.

Results from previous sampling events indicate that Libby amphibole asbestos (LA) is present within the wood chip material (CDM 2008). However, results based on this qualitative analysis method do not provide information on whether or not disturbances of wood chips under typical residential disturbance scenarios would result in unacceptable inhalation exposures.

In August 2011, the United States Environmental Protection Agency EPA and its contractors conducted activity-based sampling (ABS) over a subset of the wood chip material. The primary goal of this study was to answer the question:

*“Do concentrations of LA in air within the breathing zone of individuals that disturb OU5-derived wood chip materials exceed risk-based levels of concern?”*

The data collected during this event will be used to estimate exposure and risk from LA due to disturbances of wood chips derived from the OU5 wood chip piles, and to determine whether response actions are needed to protect individuals from unacceptable risks.

## Sample Collection Summary

ABS was completed in August 2011 in accordance with the 2011 Miscellaneous ABS Sampling Analytical Plan (ABS SAP) (CDM 2011). Due to the potential variability in LA levels within the wood chips, material was evaluated from five separate sub-locations and varied depths across

the existing wood chip at OU5. Figure 1 indicates the approximate location of the five wood chip material draws. To begin the event, approximately two cubic yards of wood chips were collected from the five locations and transported to a neutral location on OU5, near the former plywood plant. The wood chips were then spread out on plastic sheeting. The wood chips were then allowed to dry for a minimum of 24 hours prior to the start of sampling activities. Soil moisture readings were not collected as part of this event as the soil moisture meter was unable to accurately read moistures within the wood chip material, as documented within a field modification to the ABS SAP (CDM 2011). In addition, wood chip samples were collected during dry and warm weather conditions in August.

A total of three ABS events were conducted over each of the five wood chip piles. At the start of each event, one 30-point composite sample of wood chips was collected. The wood chips were then shoveled into a pile near the center of the plastic sheeting.

Two ABS air samples (high volume primary and low volume backup) were then collected while scripted activities were conducted over a one hour period. These activities were conducted in accordance with Appendix A of the ABS SAP (CDM 2011) and included:

1. Spread the wood chips out using a long handled shovel – 10 minutes
2. Rake the wood chips out to approximately 10 feet by 10 feet by 6 inch deep – 20 minutes
3. While seated, dig with a trowel at 6 separate locations – 30 minutes (6 minutes at each location)

After completing three events over each pile, the wood chip material was returned to the approximate location where it was originally retrieved from.

## **Analytical Summary and Results**

Wood chip ABS was completed August 30, 2011. Bulk material samples and air samples were submitted for analysis as outlined in the ABS SAP.

Wood chip samples were prepared in accordance with Section 6.0 of Standard Operating Procedure (SOP) DUFF-LIBBY-OU3. The resulting filters were analyzed for LA using Transmission Electron Microscopy (TEM) in basic accordance with International Organization for Standardization (ISO) 10312:1995(E) (ISO 1995) protocols, except that the aspect ratio criterion will be 3:1 to allow for the estimation of phase contrast microscopy – equivalent. In addition, all project specific modifications were applied. Results for the wood chip samples are presented in Table 1.

ABS air samples were analyzed for LA using TEM in basic accordance with ISO 10312:1995(E) (ISO 1995) and all applicable project-specific laboratory modifications. The analytical sensitivity

was sufficient to support risk-based decisions based on the draft toxicity values for LA. Results for the ABS air samples are presented in Table 2.

One bulk wood chip sample result indicated the presence of LA (1/15), while all other wood chip samples were non-detect. All of the ABS air sample results were non-detect for LA (0/15). Based on the wood chip ABS sampling data, disturbance of the wood chips did not result in detectable fiber emissions from the material and thus the EPA determined there was no potential human exposure to LA from the material. Without fibers being detected, risks were not estimated as there was no exposure.

## References

CDM. 2008. Final Sampling Summary Report 2007 Investigations Operable Unit 5 – Former Stimson Lumber Company. July 25.

\_\_\_\_. 2011. Sampling and Analysis Plan 2011 Miscellaneous Activity-based Sampling, Revision 1. September.

ISO. 1995. International Organization for Standardization Ambient Air. Determination of asbestos fibres – Direct-transfer transmission electron microscopy method. ISO 10312:1995(E). [http://www.iso.org/iso/catalogue\\_detail.htm?csnumber=18358](http://www.iso.org/iso/catalogue_detail.htm?csnumber=18358)

Table 1:  
**2011 OU4 MISCELLANEOUS ACTIVITY-BASED SAMPLING WOOD CHIP RESULTS**  
SCENARIO 3: OU5 WOOD CHIP DISTURBANCE ACTIVITIES

| Wood Chip Material Draw | Event # | Index ID  | Sample Mass (g dw) | Ashed Residue Mass (g dw) | EFA (mm <sup>2</sup> ) | GOs Counted | GO Area (mm <sup>2</sup> ) | Ashed residue mass (g), aliquot used in dilution | Resusp. volume (mL) | Volume applied to filter (mL) | F-factor | Sensitivity (1/g) | N LA Structures Observed | LA Conc. (\$/g dw) | Est. LA Conc. (mass %) |
|-------------------------|---------|-----------|--------------------|---------------------------|------------------------|-------------|----------------------------|--------------------------------------------------|---------------------|-------------------------------|----------|-------------------|--------------------------|--------------------|------------------------|
| 1                       | 1       | EX-30201  | 12.68              | 0.11                      | 1280                   | 4           | 0.013                      | 0.05                                             | 100                 | 1                             | 4.5E-03  | 4.3E+05           | 0                        | 0.0E+00            | 0.0%                   |
|                         | 2       | EX-30202  | 24.45              | 0.28                      | 1280                   | 4           | 0.013                      | 0.15                                             | 100                 | 0.8                           | 4.3E-03  | 2.3E+05           | 1                        | 2.3E+05            | 0.000012%              |
|                         | 3       | EX-30203  | 51.94              | 0.74                      | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 1.7E-03  | 2.8E+05           | 0                        | 0.0E+00            | 0.0%                   |
| 2                       | 1       | EX-30209  | 35.52              | 0.5                       | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 2.5E-03  | 2.8E+05           | 0                        | 0.0E+00            | 0.0%                   |
|                         | 2       | EX-30210  | 48.78              | 0.9                       | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 1.4E-03  | 3.6E+05           | 0                        | 0.0E+00            | 0.0%                   |
|                         | 3       | EX-30211  | 47.45              | 0.52                      | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 2.4E-03  | 2.2E+05           | 0                        | 0.0E+00            | 0.0%                   |
| 3                       | 1       | EX-30205  | 64.04              | 1.22                      | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 1.0E-03  | 3.8E+05           | 0                        | 0.0E+00            | 0.0%                   |
|                         | 2       | EX-30207  | 72.69              | 1.43                      | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 8.7E-04  | 3.9E+05           | 0                        | 0.0E+00            | 0.0%                   |
|                         | 3       | EX-30208  | 50.7               | 0.83                      | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 1.5E-03  | 3.2E+05           | 0                        | 0.0E+00            | 0.0%                   |
| 4                       | 1       | EX-30212  | 46.47              | 4.36                      | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 2.9E-04  | 1.8E+06           | 0                        | 0.0E+00            | 0.0%                   |
|                         | 2       | EX-30213  | 43.58              | 12.77                     | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 9.8E-05  | 5.8E+06           | 0                        | 0.0E+00            | 0.0%                   |
|                         | 3       | EX-30214  | 38.88              | 9.43                      | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 1.3E-04  | 4.8E+06           | 0                        | 0.0E+00            | 0.0%                   |
| 5                       | 1       | EX-30215  | 48.69              | 0.8                       | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 1.6E-03  | 3.2E+05           | 0                        | 0.0E+00            | 0.0%                   |
|                         | 2       | EX-30216  | 56.15              | 0.74                      | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 1.7E-03  | 2.6E+05           | 0                        | 0.0E+00            | 0.0%                   |
|                         | 3       | EX-30217  | 67.86              | 1.28                      | 1280                   | 4           | 0.013                      | 0.25                                             | 100                 | 0.5                           | 9.8E-04  | 3.7E+05           | 0                        | 0.0E+00            | 0.0%                   |
| Field Duplicates        |         |           |                    |                           |                        |             |                            |                                                  |                     |                               |          |                   |                          |                    |                        |
|                         |         | EX-30204  | 49.05              | 0.81                      | 1280                   | 4           | 0.013                      | 0.25                                             | 10                  | 0.5                           | 1.5E-02  | 3.3E+04           | 0                        | 0.0E+00            | 0.0%                   |
|                         |         | EX-30206  | 71.78              | 1.33                      | 1280                   | 4           | 0.013                      | 0.25                                             | 10                  | 0.5                           | 9.4E-03  | 3.6E+04           | 0                        | 0.0E+00            | 0.0%                   |
| Laboratory QC Analyses  |         |           |                    |                           |                        |             |                            |                                                  |                     |                               |          |                   |                          |                    |                        |
|                         |         | Lab Blank | ---                | ---                       | 1280                   | 10          | 0.013                      |                                                  |                     |                               | 1.0E+00  | ---               | 0                        | ---                | ---                    |
|                         |         |           |                    |                           |                        |             |                            |                                                  |                     |                               |          | 1.1E+06           | mean:                    | 1.6E+04            | 0.0000008%             |

Note:  
dw = dry weight  
g = gram  
GO = grid opening  
ID = identification  
LA = Libby amphibole asbestos  
mm<sup>2</sup> = square milimeters  
mL = mililiter  
N = number

**Table 2:**  
**2011 OU4 MISCELLANEOUS ACTIVITY-BASED SAMPLING AIR RESULTS**  
SCENARIO 3: OU5 WOOD CHIP DISTURBANCE ACTIVITIES

| Wood Chip Material Draw | Event # | ABS Air Sample ID* | Sample Collection Date | Sample Collection Time | Sample Air Volume (L) | Number Grid Openings Examined | Analysis Sensitivity** (1/cc) | Number of PCME LA Structures | PCME LA ABS Air Conc. (s/cc) |
|-------------------------|---------|--------------------|------------------------|------------------------|-----------------------|-------------------------------|-------------------------------|------------------------------|------------------------------|
| 1                       | 1       | EX-30222           | 8/24/11                | 9:11 AM - 10:12 AM     | 347                   | 200                           | 0.00043                       | 0                            | 0.0                          |
|                         | 2       | EX-30223           | 8/24/11                | 10:43 AM - 11:43 AM    | 341                   | 200                           | 0.00043                       | 0                            | 0.0                          |
|                         | 3       | EX-30226           | 8/24/11                | 1:53 PM - 2:53 PM      | 341                   | 200                           | 0.00043                       | 0                            | 0.0                          |
| 2                       | 1       | EX-30238           | 8/25/11                | 8:51 AM - 9:51 AM      | 332                   | 105                           | 0.00085                       | 0                            | 0.0                          |
|                         | 2       | EX-30241           | 8/25/11                | 10:16 AM - 11:16 AM    | 328                   | 105                           | 0.00086                       | 0                            | 0.0                          |
|                         | 3       | EX-30243           | 8/25/11                | 3:10 PM - 4:10 PM      | 328                   | 200                           | 0.00045                       | 0                            | 0.0                          |
| 3                       | 1       | EX-30231           | 8/24/11                | 3:15 PM - 4:15 PM      | 341                   | 105                           | 0.00083                       | 0                            | 0.0                          |
|                         | 2       | EX-30235           | 8/24/11                | 4:55 PM - 5:55 PM      | 338                   | 105                           | 0.00083                       | 0                            | 0.0                          |
|                         | 3       | EX-30237           | 8/24/11                | 6:28 PM - 7:28 PM      | 328                   | 105                           | 0.00086                       | 0                            | 0.0                          |
| 4                       | 1       | EX-30245           | 8/25/11                | 4:20 PM - 5:20 PM      | 328                   | 200                           | 0.00045                       | 0                            | 0.0                          |
|                         | 2       | EX-30248           | 8/26/11                | 8:27 AM - 9:27 AM      | 335                   | 200                           | 0.00044                       | 0                            | 0.0                          |
|                         | 3       | EX-30250           | 8/26/11                | 9:45 AM - 10:45 AM     | 338                   | 200                           | 0.00044                       | 0                            | 0.0                          |
| 5                       | 1       | EX-30252           | 8/30/11                | 1:47 PM - 2:47 PM      | 328                   | 200                           | 0.00045                       | 0                            | 0.0                          |
|                         | 2       | EX-30254           | 8/30/11                | 3:16 PM - 4:16 PM      | 328                   | 200                           | 0.00045                       | 0                            | 0.0                          |
|                         | 3       | EX-30256           | 8/30/11                | 4:35 PM - 5:35 PM      | 328                   | 105                           | 0.00086                       | 0                            | 0.0                          |

\*High volume filter was able to be directly prepared for all samples.

\*\*Target analysis sensitivity changed from 0.00044 to 0.00088 cc<sup>-1</sup> during the course of the analyses.

Note:

ABS = activity-based sampling

cc = cubic centimeters

Conc. = concentration

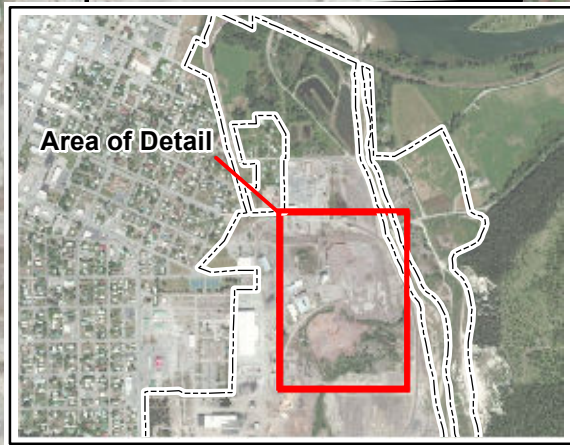
ID = identification

L = liters

LA = Libby amphibole

PCME = phase contrast microscopy equivalent

s/cc = structures per cubic centimeter



Wood Chip  
Material  
Draw #5

Power House and  
Power House Office

Storage and  
Locomotive Shed

Finger Jointer  
Processing Plant

Shed 12




Wood Chip  
Material  
Draw #4

Wood Chip  
Material  
Draw #1

Wood Chip  
Material  
Draw #3

Wood Chip  
Material  
Draw #2

### Legend

- Wood Chip Material Draw # Location
-  Buildings
-  Wood Chip Piles
-  OU5 Boundary

© Bing Maps 2012

The OU boundaries depicted are based on the definitions found in the Libby Asbestos Conceptual Site Model, Revision 19. Because investigation of the nature and extent of contamination continues, the OU boundaries are subject to change. These OU boundaries are current as of August 2007.



Scale of Feet

0 50 100 200 300 400

1 inch = 200 feet

**Figure 1**  
**Wood Chip ABS Material**  
**Draw Locations**

Libby Asbestos Project  
Libby, Montana

**CDM**  
**Smith**

**Appendix F2**  
**Proposed Fishing Pond Pre-design Investigation**  
**(at Former Tree Nursery)**

875 US Highway 2  
Proposed Fishing Pond Location  
AD-000686  
6/6/12, 6/7/12, 6/15/12, 6/18/12, 6/19/12, 6/27/12  
DI Visible and Analytical Sketch  
M. Jackson, M. Luick, D. Coleman, J. Peltier,  
K. Anderson, A. Vivian, C. Hislop (CDM Smith)

Blue areas sampled  
during 2008 visit

Approximate location  
of fence line.

Legend

PLM-VE Results



Trace Result



Non-detect Result

Pile of building debris.  
No VCI observed.  
No sample taken.

Pile of wood chips,  
not sampled

500 ft

PLM-VE

| ZONE | TYPE | AREA(FT <sup>2</sup> ) | X  | L  | M | H | LOCATION ID | SAMPLE ID | RESULT |
|------|------|------------------------|----|----|---|---|-------------|-----------|--------|
| 1    | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146860   | 7-00041   | ND     |
| 2    | LUA  | 15000                  | 29 | 1  | 0 | 0 | SP-146861   | 7-00042   | ND     |
| 3    | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146862   | 7-00043   | ND     |
| 4    | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146863   | 7-00044   | ND     |
| 5    | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146864   | 7-00045   | ND     |
| 6    | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146865   | 7-00046   | ND     |
| 7    | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146866   | 7-00047   | TR     |
| 8    | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146867   | 7-00048   | ND     |
| 9    | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146868   | 7-00049   | ND     |
| 10   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146869   | 7-00050   | ND     |
| 11   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146870   | 7-00051   | ND     |
| 12   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146871   | 7-00052   | ND     |
| 13   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146872   | 7-00053   | ND     |
| 14   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146873   | 7-00054   | ND     |
| 15   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146874   | 7-00055   | ND     |
| 16   | LUA  | 15000                  | 28 | 2  | 0 | 0 | SP-146875   | 7-00056   | ND     |
| 17   | LUA  | 15000                  | 15 | 15 | 0 | 0 | SP-146876   | 7-00057   | ND     |
| 18   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146877   | 7-00058   | ND     |
| 19   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146878   | 7-00059   | ND     |
| 20   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146879   | 7-00060   | ND     |
| 21   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146880   | 7-00061   | TR     |
| 22   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146881   | 7-00062   | TR     |
| 23   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146882   | 7-00063   | ND     |
| 24   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146883   | 7-00064   | TR     |
| 25   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146884   | 7-00065   | TR     |
| 26   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146885   | 7-00066   | TR     |
| 27   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146886   | 7-00067   | ND     |
| 28   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146887   | 7-00068   | TR     |
| 29   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146888   | 7-00077   | ND     |
| 30   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146889   | 7-00078   | TR     |
| 31   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146890   | 7-00079   | ND     |
| 32   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146891   | 7-00080   | ND     |
| 33   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146892   | 7-00081   | ND     |
| 34   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146893   | 7-00082   | ND     |
| 35   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146894   | 7-00083   | ND     |
| 36   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146895   | 7-00084   | ND     |
| 37   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146896   | 7-00085   | ND     |
| 38   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146905   | 7-00086   | ND     |
| 39   | LUA  | 15000                  | 28 | 2  | 0 | 0 | SP-146906   | 7-00087   | TR     |

Note: Square footage is approximate and is not intended for use in the design process.

TEM-ISO

| ZONE | TYPE | AREA(FT <sup>2</sup> ) | X  | L | M | H | LOCATION ID | SAMPLE ID | RESULT             |
|------|------|------------------------|----|---|---|---|-------------|-----------|--------------------|
| 29   | LUA  | 15000                  | 30 | 0 | 0 | 0 | SP-146888   | 7-00069   | ND                 |
| 30   | LUA  | 15000                  | 30 | 0 | 0 | 0 | SP-146889   | 7-00070   | ND                 |
| 31   | LUA  | 15000                  | 30 | 0 | 0 | 0 | SP-146890   | 7-00071   | ND                 |
| 32   | LUA  | 15000                  | 30 | 0 | 0 | 0 | SP-146891   | 7-00072   | ND                 |
| 33   | LUA  | 15000                  | 30 | 0 | 0 | 0 | SP-146892   | 7-00073   | 9.61E+06 s/g       |
| 34   | LUA  | 15000                  | 30 | 0 | 0 | 0 | SP-146893   | 7-00074   | ND                 |
| 35   | LUA  | 15000                  | 30 | 0 | 0 | 0 | SP-146894   | 7-00075   | ND                 |
| 36   | LUA  | 15000                  | 30 | 0 | 0 | 0 | SP-146895   | 7-00076   | Analysis Cancelled |

Note: Square footage is approximate and is not intended for use in the design process.

2007 Former Nursery Area Results

| ZONE | X  | L | M | H | LOCATION ID | SAMPLE ID | RESULT |
|------|----|---|---|---|-------------|-----------|--------|
| A    | 27 | 3 | 0 | 0 | SP-136375   | SL-70068  | ND     |
| B    | 29 | 1 | 0 | 0 | SP-136377   | SL-70070  | ND     |
| C    | 25 | 5 | 0 | 0 | SP-136374   | SL-70067  | ND     |
| D    | 29 | 1 | 0 | 0 | SP-136376   | SL-70069  | ND     |
| E    | 21 | 6 | 2 | 1 | SP-136378   | SL-70071  | ND     |
| F    | 25 | 5 | 0 | 0 | SP-136380   | SL-70073  | TR     |
| G    | 24 | 5 | 1 | 0 | SP-136381   | SL-70074  | TR     |
| H    | 25 | 4 | 1 | 0 | SP-136379   | SL-70072  | 1%     |
| I    | 30 | 0 | 0 | 0 | SP-136383   | SL-70076  | ND     |
| J    | 27 | 3 | 0 | 0 | SP-136382   | SL-70075  | ND     |
| K    | 28 | 1 | 1 | 0 | SP-136384   | SL-70077  | TR     |

Note: Test pit results for waste bark pile sampling all ND except the 6-8 ft interval in zone 35 which had a PLM-9002 TR result.

875 US Highway 2  
Proposed Fishing Pond Location  
AD-000686  
6/6/12, 6/7/12, 6/15/12, 6/18/12, 6/19/12, 6/27/12  
DI Visible and Analytical Sketch  
M. Jackson, M. Luick, D. Coleman, J. Peltier,  
K. Anderson, A. Vivian, C. Hislop (CDM Smith)

Legend

PLM-VE Results

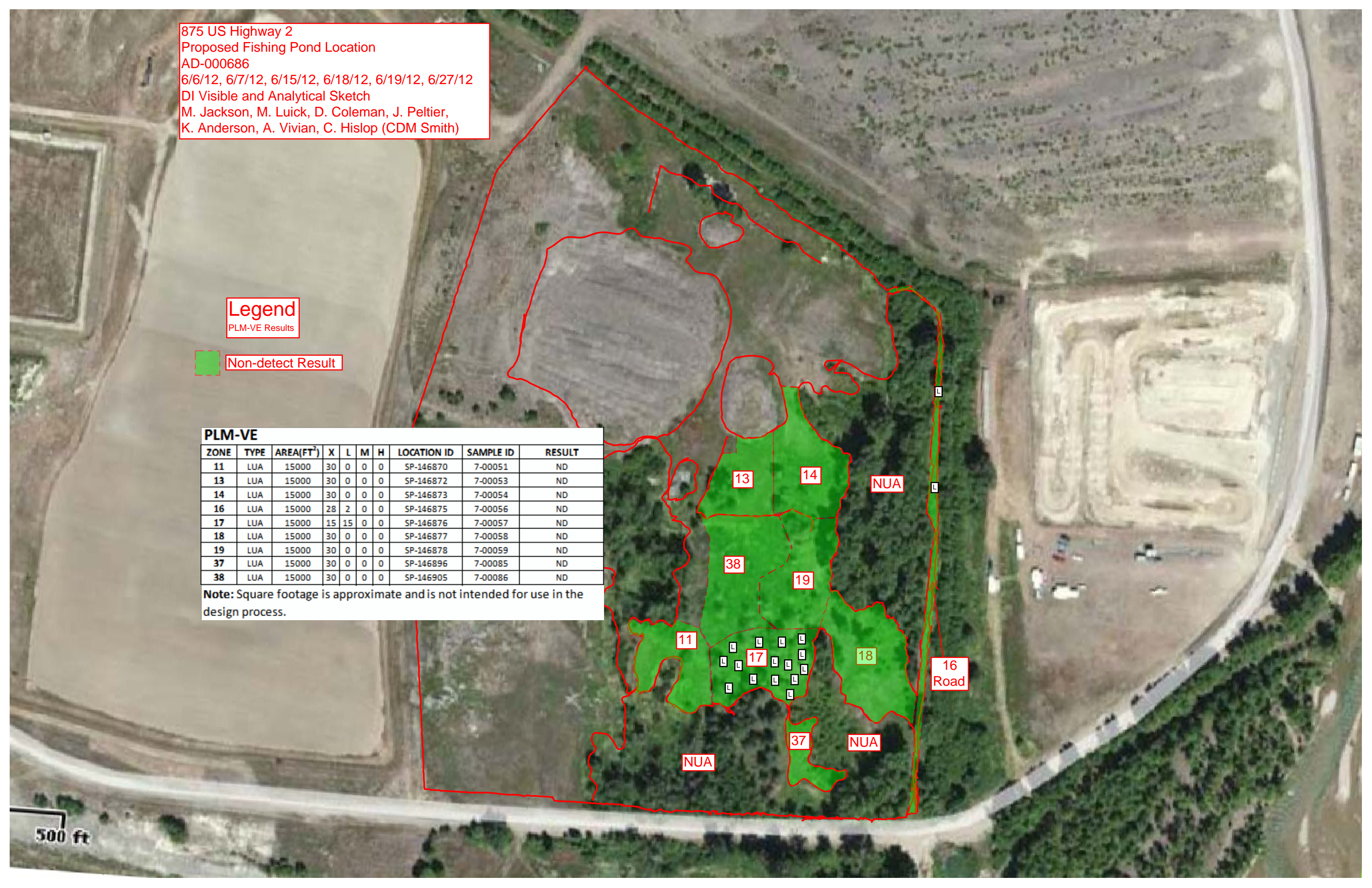


Non-detect Result

PLM-VE

| ZONE | TYPE | AREA(FT <sup>2</sup> ) | X  | L  | M | H | LOCATION ID | SAMPLE ID | RESULT |
|------|------|------------------------|----|----|---|---|-------------|-----------|--------|
| 11   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146870   | 7-00051   | ND     |
| 13   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146872   | 7-00053   | ND     |
| 14   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146873   | 7-00054   | ND     |
| 16   | LUA  | 15000                  | 28 | 2  | 0 | 0 | SP-146875   | 7-00056   | ND     |
| 17   | LUA  | 15000                  | 15 | 15 | 0 | 0 | SP-146876   | 7-00057   | ND     |
| 18   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146877   | 7-00058   | ND     |
| 19   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146878   | 7-00059   | ND     |
| 37   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146896   | 7-00085   | ND     |
| 38   | LUA  | 15000                  | 30 | 0  | 0 | 0 | SP-146905   | 7-00086   | ND     |

Note: Square footage is approximate and is not intended for use in the design process.



1670 Broadway  
Suite 3400  
Denver, CO 80202  
p. (303) 764 - 1520  
f. (303) 860 - 7139

2060 Briargate Parkway  
Suite 120  
Colorado Springs, CO 80920  
p. (719) 272 - 8800  
f. (719) 272 - 8801

419 Canyon Blvd.  
Suite 316  
Fort Collins, CO 80524  
p. (970) 419 - 4388  
f. (970) 419 - 4389

## FINAL Remedial Investigation Report

# Operable Unit 5 Libby Asbestos National Priorities List Site

June 2013